JULY

Popular Science

Founded MONTHLY

Observation Officer
Jumping to Safety. See page 50.

Popular Science Monthly

Volume 91
July-December, 1917

Modern Publishing Company
225 West 39th Street
New York

This volume contains:

960 pages

1306 articles

2082 pictures

Popular Science Monthly

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Volume 91—July-December, 1917

MECHANICAL ENGINEERING

MEDICINE, SURGERY AND HYGIENE

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239 Fourth Ave., New York

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Contents for July, 1917

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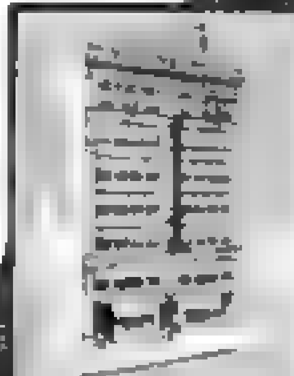

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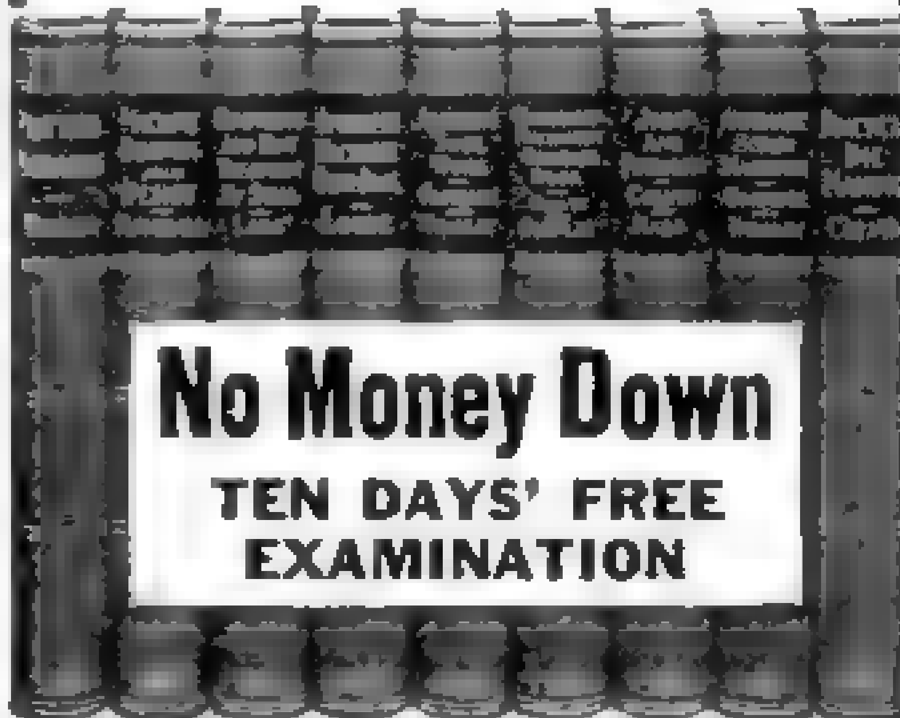

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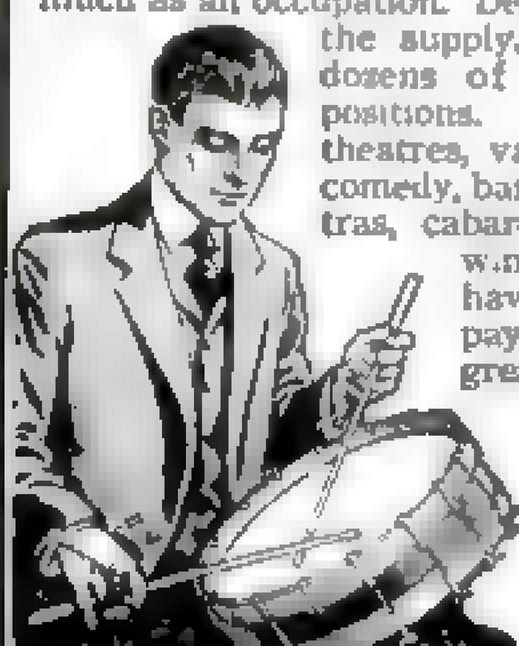

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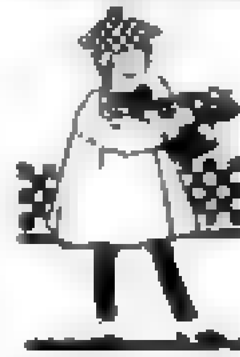

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Bradley A. Fiske

The First Successful Fliers of Man and Nature

About seven million years ago the first bird began to fly. Flight was merely gliding, and clumsy gliding at that, which developed from the about-to-be birds instinctively spreading their limbs when falling from trees or jumping up in exuberance of spirits. Notice how closely the lines and movements of the first living flier resemble those of the pioneer motor-driven flier behind it

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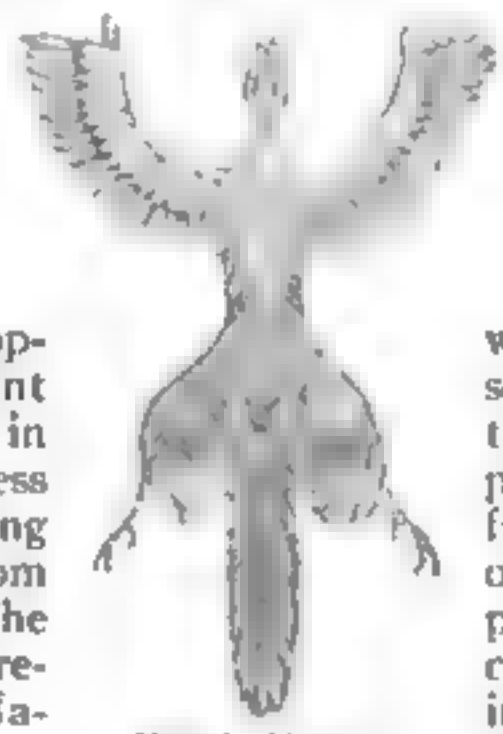
A Bird with Four Wings

When Nature decided to evolve a bird out of a reptile she molded a four-winged flyer curiously like the first flying machine

By Maurice Krosby

BIRDS came later than fishes and reptiles in the evolution of life. But what manner of creature was it that linked fish with bird? What was the first bird that ever flew? Fossil remains and imprints have so far given only scant information as to how the feathered descendants of the fish or the reptile gradually came into possession of the power of flight. Intermediate links in the development have left but few and faint traces, and this is due, at least in part, to the extreme remoteness of the transition period during which birds became birds from whatever they were before. The change was so radical that it required millions of years by Nature's slow methods.



This is Nature's first attempt at creating a flyer

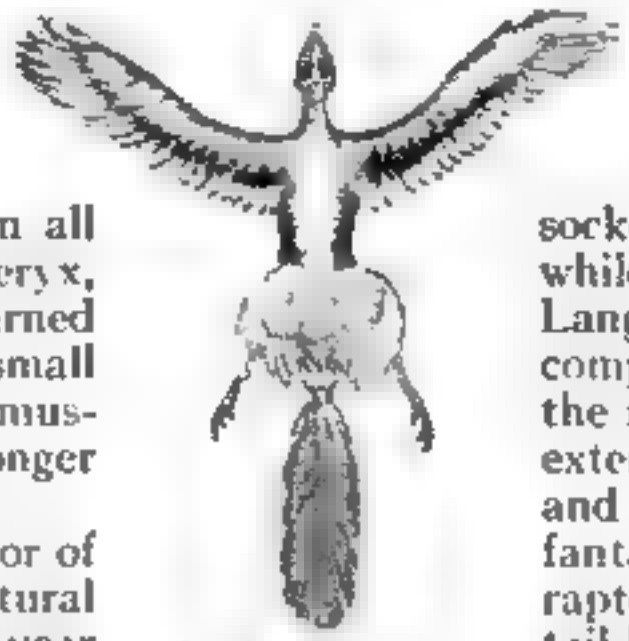
Fortunately a single natural document has come down through the ages which goes far toward explaining the mechanics that made the elongated swimming fish or crawling reptile fit for sustaining, propelling and balancing itself in the air, and this document, as it happens, also establishes a most curious and interesting parallel between Nature's experiments in flying and those fundamental experiments by Professor Langley of the Smithsonian Institution in Washington to which the inauguration of the airplane era in flight is due, more than to any other one cause. The document referred to is a true document; for it was found printed by natural forces on the rocks of the Solinghofen quarry in Germany. Here, in a formation not less than seven million years old, one of the ancestors of the modern bird, a strange feathered reptile, had been imprisoned, caught unawares perhaps in one of the every-day upheavals of that formative age when mountain ranges, continents and oceans were still in the making. Its skeleton, its outlines and its feathers are here preserved, stamped in unmistakable distinctness in stone, which is now hard but which must have been plastic as clay when the fluttering creature was seized in deadly embrace. More than twice as old as any of the prehistoric monsters reconstructed from their bones in our museums of natural history, the fossil imprint of the Tetrapteryx, as this creature has been named (meaning "four-winger"), represents an indisputable and descriptive record of perhaps the earliest feathered flyer.

The Tetrapteryx record was discovered fifty-five years ago, but science has only recently undertaken to interpret it mechanically. William C. Beebe, while curator of birds at the New York Zoological Park, demonstrated that several species of modern birds, and especially the white-winged dove, show very marked traces of just such wings on the legs, called pelvic wings, as the Tetrapteryx record reveals. On the very young dove, at the time when its body is still bare but for the sprouting flight feathers of wings and tail, twelve flight feathers and six coverts begin to grow from the outer and upper edge of the leg, extending in two rows from the knee almost to the base of the tail. While the growth of these tell-tale feathers is soon arrested and is covered up

in the surrounding plumage, so that the grown bird shows only traces, the fact that the young of the species pass rapidly through the same evolution that is represented in the succession of innumerable generations of their ancestry, almost clinches the conclusion that birds are descended from a type equipped with wings on all four limbs, as the Tetrapteryx, and that Nature has learned gradually to replace four small and imperfect wings, weakly muscled, by two larger and stronger wings under perfect control.

Frederic A. Lucas, Director of the American Museum of Natural History, called attention last year in the American Museum Journal to the great force of the evidence which has thus been collected to prove how Nature learned to accomplish flight, the interest centering in birds, on account of their considerable weight, rather than in bats and insects.

The ancestor-bird, faithfully reproduced from the record, and the ancestor-airplane are presented in illustration herewith, side by side. The dimensions of the bird have been relatively exaggerated to facilitate the comparison, and the resemblance in structure is striking. Langley's "aerodrome" repeatedly flew over the Potomac in 1895, sustaining its own weight in the air for more than one minute at a time by the action of its two pairs of planes or wings and two rotary propellers, of five to six feet diameter, driven from a diminutive steam engine developing one to one and one-half horsepower. The necessity for placing the power equipment and the propellers amidships called for an elongated body for the machine as a whole, so that the weight might be evenly supported by planes at the rear as well as in front. This constructive difficulty has been overcome in modern airplanes, but it was decisive for Langley's machine, with its small power, in the same degree and almost for the same reasons as for the original, four-winged bird. The latter came from a race whose fore and hind limbs were spaced well apart, whose legs were relatively heavy and whose arm muscles were weak. Its structure had to be modified by hereditary influences before it would balance at all in the air, hung from the arm sockets alone, as birds do. Meanwhile Nature did practically as Langley did. She adopted the compromise solution of upholding the rear weight by large feathery extensions from the legs and tail, and it may be noticed that the fantastic feather tail of the Tetrapteryx was built up around a tail-like appendage and was not all feathers under muscular control like that of the modern bird. Nature evidently found it impossible to change the bony structure in less than millions of years, working from the basis of a reptile with only growth and heredity as the tools at command, but she could make feathers grow in the place of horny scales, which are made of almost the same material, by a comparatively brief evolution.



As the wings increased in power the rear wing decreased in size

Gradually the tail shortened and the feathers lengthened

The fan-shaped tail of the bird of to-day is a kind of a rudder

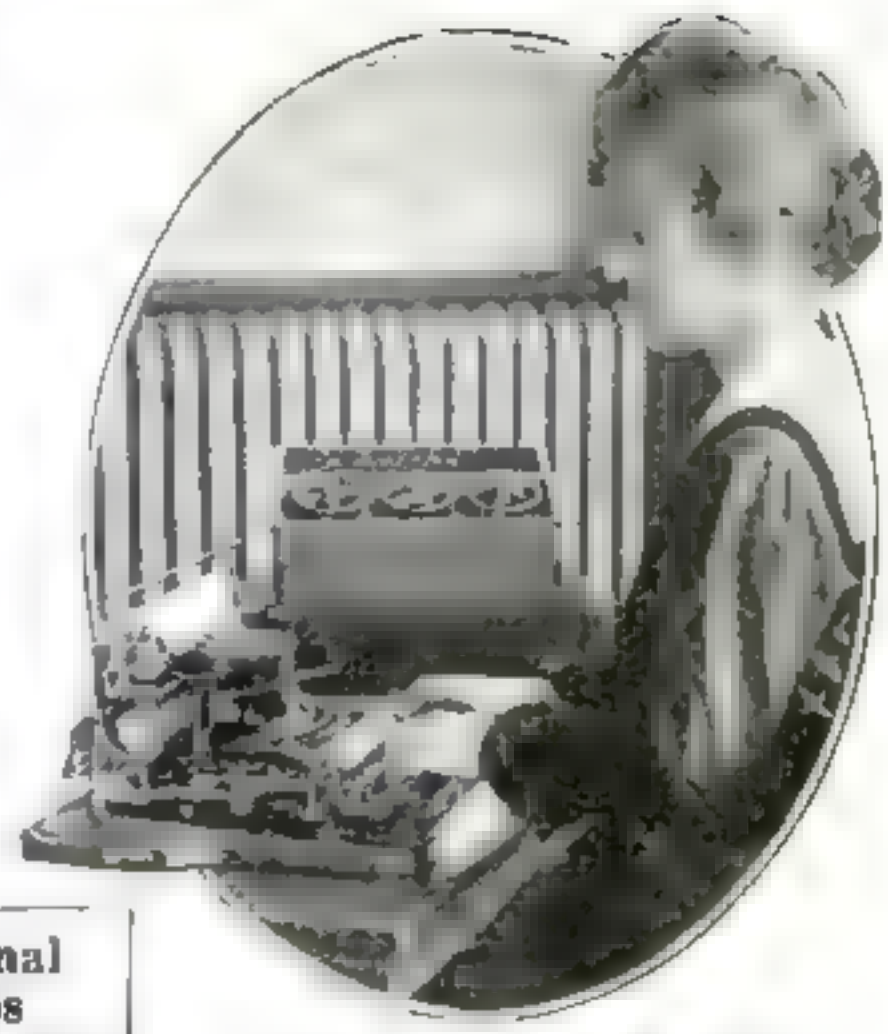
To transform Langley's machine into the modern airplane was a task much simplified by the advent of the compact and powerful gasoline engine, small enough to be moved forward in line with the support from planes arranged on the biplane or monoplane principle and strong enough to pull the machine safely, in most cases, through disturbing eddies of the atmosphere.

This decided change in the machine took the place of all the transformations in bone dimensions, balance and muscle strength by which the Tetrapteryx became a bird after starting out in the world with an anatomical construction very much like an animated parachute or gliding machine. But the mechanical flyer is still an infant compared with Nature's eon-old product.

This Typewriter Prints in Every Type and Language

THE multiplex typewriter, shown on the right, can type in all the languages and in hundreds of different styles of type. Naturally, it is radically different from the usual machine. Instead of having fifty different type blocks all mounted on separate steel bars, it uses one plate on which all the characters of one style are cast. This plate is removably attached to the machine. By sliding it off and sliding on another plate having a different set of characters, the typewriter is converted instantly.

Two different plates, in fact, can be carried in the machine at one time. These plates are curved and can be adjusted into



A typewriter which prints any kind of type. Samples of its work appear on the left

The advertising manager can send his copy to the printer looking just as he wants it to look in type

guists, to physicians and to all who have to use unusual characters, this typewriter is invaluable to the advertising man. An advertising manager of a large department store, for instance, can send his advertisement to the newspapers all written in the correct style and size of type.

a slot in the circular type-carrier after the carrier has been withdrawn from the machine. The type-carrier fits into the center of the machine. When a key is pressed, an automatic spring mechanism turns the carrier until the corresponding character on the plate faces the front. At the same time, a hammer at the back is released to knock the writing paper against the ribbon and the character. The actual impression of the character is thus made on the same principle as in other typewriters.

Besides being of especial value to lin-

This Railroad Crossing Cleans Itself and Eliminates Jolts

WHEREVER a road crosses railway tracks, this light weight steel crossing belongs.

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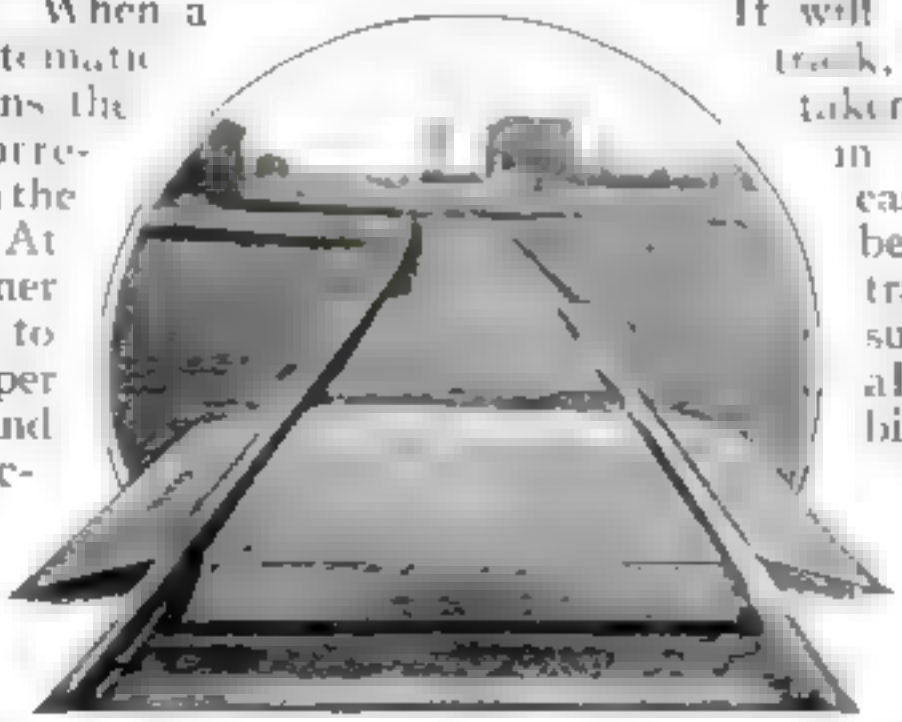
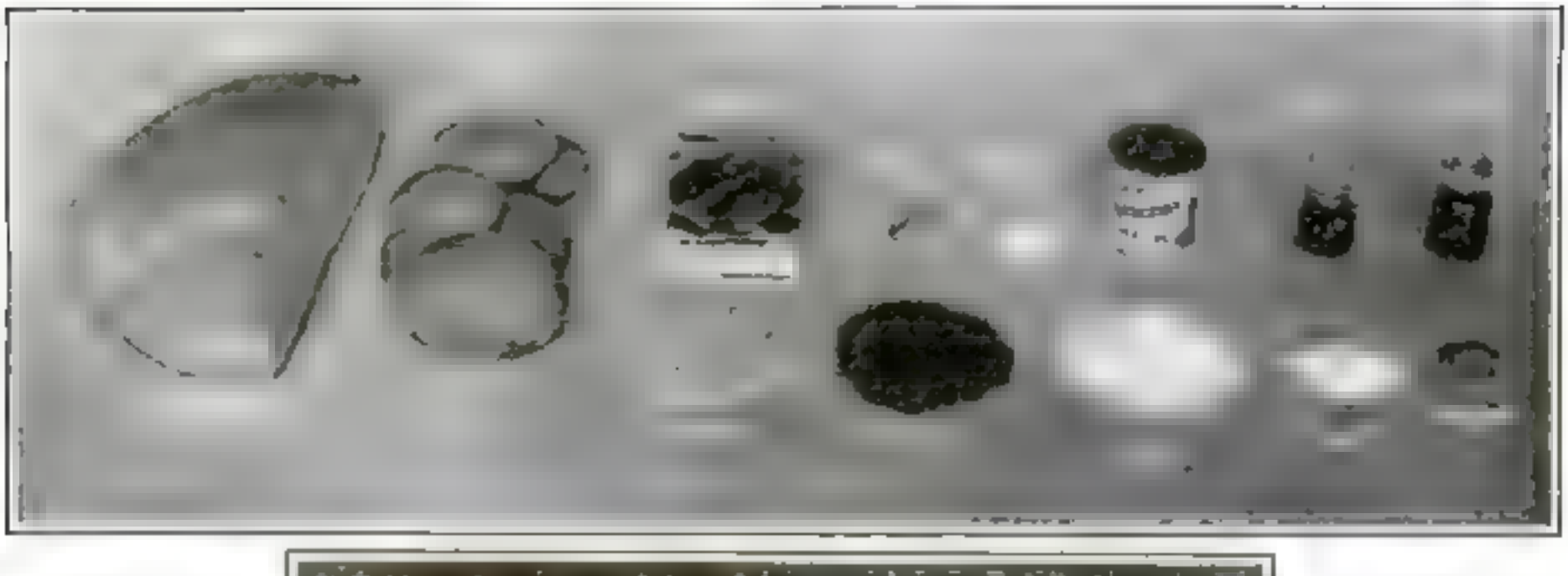


This crossing provides a level space between the tracks and a sloping surface to the road

How Our Fighters Will Be Fed

Nothing is left to guesswork. Menus are planned by chemists and physicians



Above: The daily Army ration of the garrison or permanent camp. Other articles in prescribed quantities of equal food value may be substituted if desired

It costs the Government only about twenty-eight cents a day per man to provide such wholesome-looking meals as this on the left for the men of our Navy

Photos © Press Illus. Serv.

UNCLE SAM has written generous menus for his fighting men on land and on sea and if the regulations which he has prescribed are followed his soldiers and sailors need never go hungry. He provides approximately twenty-eight cents a day to buy food for each one of his soldiers and a like allowance is made for his sailors. To the housekeeper who has to contend with war-time prices of foodstuffs, this sum seems entirely inadequate, but it must be remembered that Uncle Sam buys his supplies in ton lots and not by the pound.

There is no guesswork in either the army or the navy when it comes to determining just how much food a man shall be given. All this has been figured out and the person charged with the responsibility of supplying the food merely follows certain tables.

The fixed allowance or portion of food furnished a soldier or sailor each day is called a ration. It consists of specified components or substitutive articles. There may be an over-issue of any ration component, provided there is an under-issue or equal value of other components; but the total cost of a man's rations at the end of a month must not exceed the average of the daily allowances for that period.

In garrison or permanent camp, a soldier's allowance of food consists of the following components and quantities, or specified quantities of substitutes: Beef, 20 oz.; flour, 18 oz.; baking powder, .08 oz.; beans, 2.4 oz.; potatoes, 20 oz.; prunes, 1.28 oz.; coffee, 1.12 oz.; sugar, 3.2 oz.; evaporated milk, .5 oz.; vinegar, .16 gill; salt, .64 oz.; black pepper, .04 oz.; cinnamon, .014 oz.; lard, .64 oz.; butter, .5 oz.; syrup, .32 gill; and flavoring extract, .014 oz. A number of substitutive articles are provided for each of the ration components. For instance, instead of the 20 ounces of beef, a like quantity of mutton may be supplied or 12 ounces of bacon, 16 of canned meat, 14 of dried fish or other meat substitutes. Instead of the bean component, 1.16 ounces of either rice or hominy may be supplied. Prescribed quantities of dried apples or peaches or of jam and preserves may be substituted for the prunes. The reserve ration is less varied.

A Photographic Trick—Try It on the Night of the Fourth

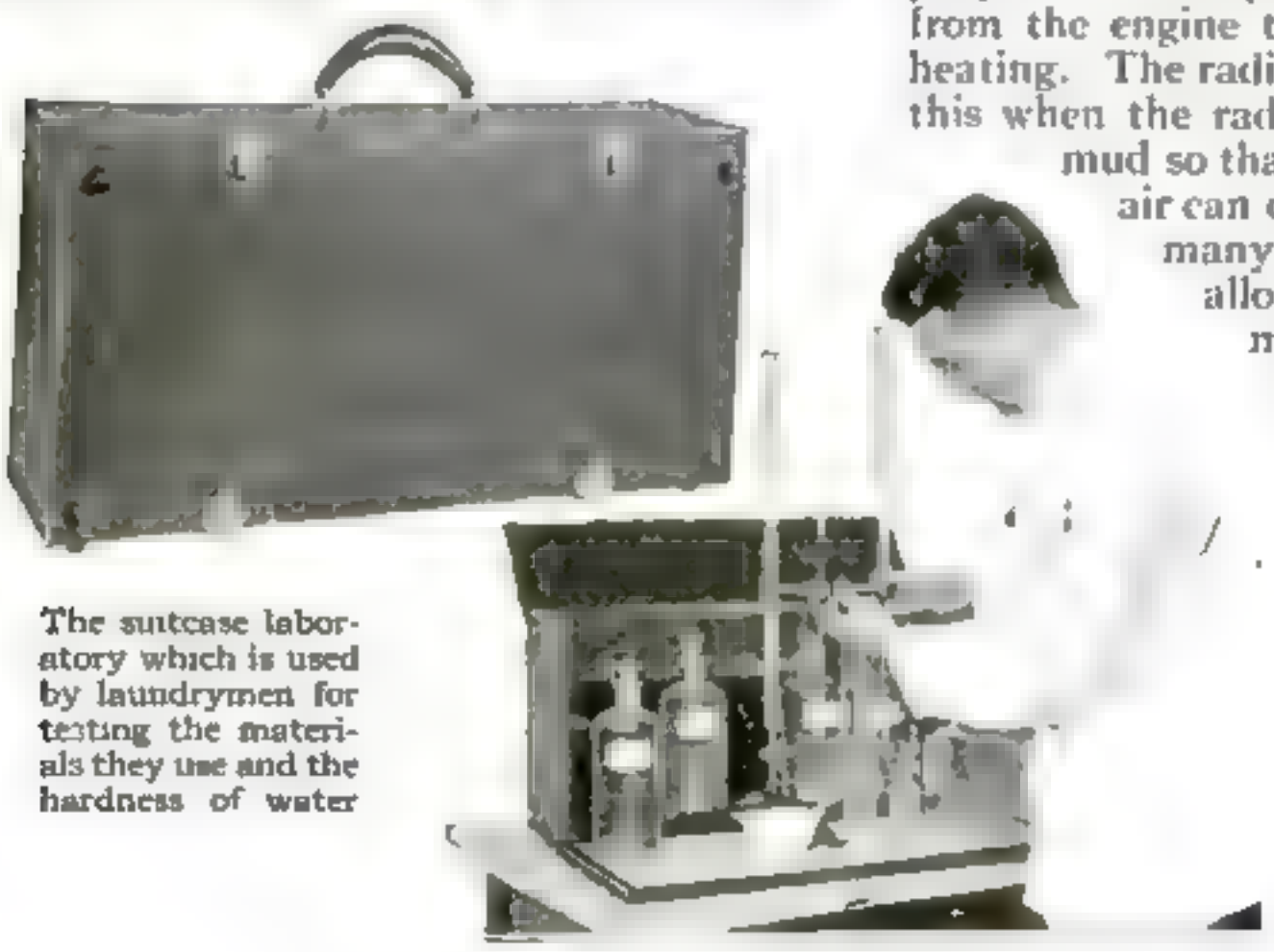
THE young man in the accompanying illustration, pictured as looking so calmly and critically at us from behind one of the rings of Saturn or some other astronomical wonder, is really standing out in his own back yard, in Hornell, New York, and posing for his photograph while whirling a sparkler, such as children delight in for the safe and sane Fourth of July celebration.

A four by five camera was used with a polychrome plate. The photograph was taken by the light of the sparkler, and the dark spot over the right shoulder is the hand which held and whirled it.

Posing for a photograph by the light of a whirling sparkler which he holds

A Suitcase Laboratory for the Use of the Laundryman

THE Mellon Institute of Industrial Research has been studying the laundry business scientifically. It wants to help the laundrymen guard against bad laundry materials. The result has been the suitcase laboratory illustrated, with which valuable information is quickly obtained as to the purity of chemicals.



The suitcase laboratory which is used by laundrymen for testing the materials they use and the hardness of water

This "pocket edition" laboratory enables the laundryman to test all his materials as he buys them. Thus he is able to assure himself that everything used in his establishment is of a sort that will not damage or harm the goods entrusted to him. In other words, he submits all his purchases to a chemical analysis, without going to the expense of hiring a chemist to do the same thing for him.

When closed, the laboratory resembles a suitcase. It becomes a laboratory by raising the handle side and lowering the side which forms the lid. The lowered side forms a table.

A Hint to Motorists—Keep Your Radiator Clean

TO assure the efficient operation and long life of your automobile, it is essential that the radiator be kept clean. Every radiator has been designed for the purpose of dissipating some of the heat from the engine to prevent it from overheating. The radiator can only accomplish this when the radiator cells are cleared of mud so that the comparatively cool air can circulate through it. Yet many are the cars which are allowed to clog up with mud and dirt until it almost takes a hammer to knock it out. A good antidote is a powerful stream of water from a hose; or where this may not be convenient, a stiff brush or a broom will assist in solving the cleaning problem.

Care in this respect will be repaid in good measure.

The Flag Equipment of an American Battleship

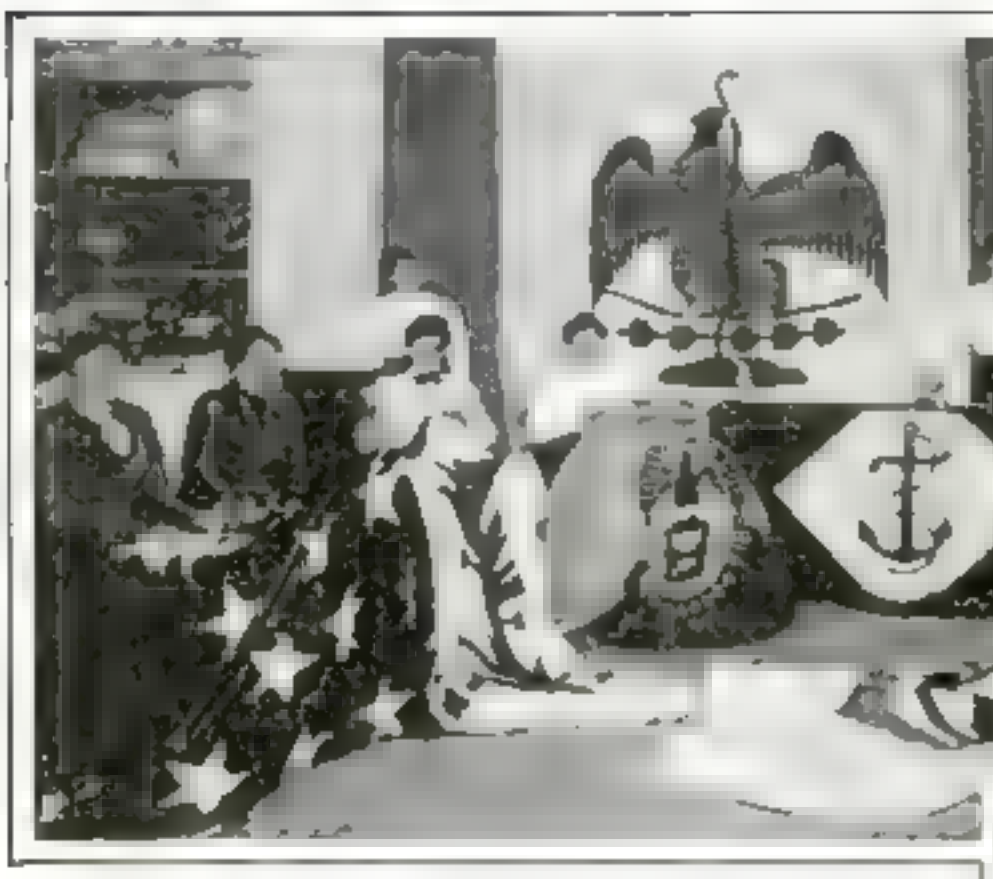
At left: Centerpiece of the flag of Salvador, difficult and expensive to make. At right Centerpiece of the flag of Costa Rica, which requires more than two weeks to make

At right: The dragon flag of China and the white elephant of Siam

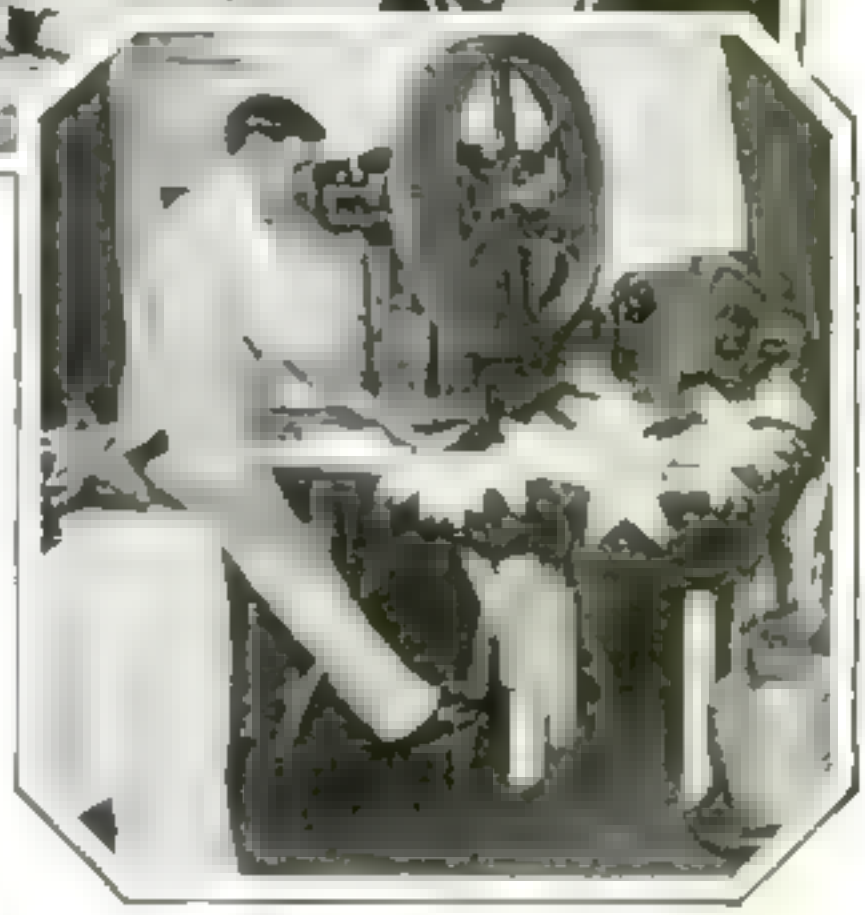
Brow Meas uring and cutting the lags This a laborious

The complete flag equipment of an American battleship. About 250 flags are carried. Each flag is carefully rolled and packed away in a waterproof bag to await future use

Consists of 250 Flags of Various Kinds Costing $2,500



Hand sewers putting in centerpieces of foreign flags. In the background is the Mexican flag



Above How the stars are cut out A machine does the work accurately and expeditiously

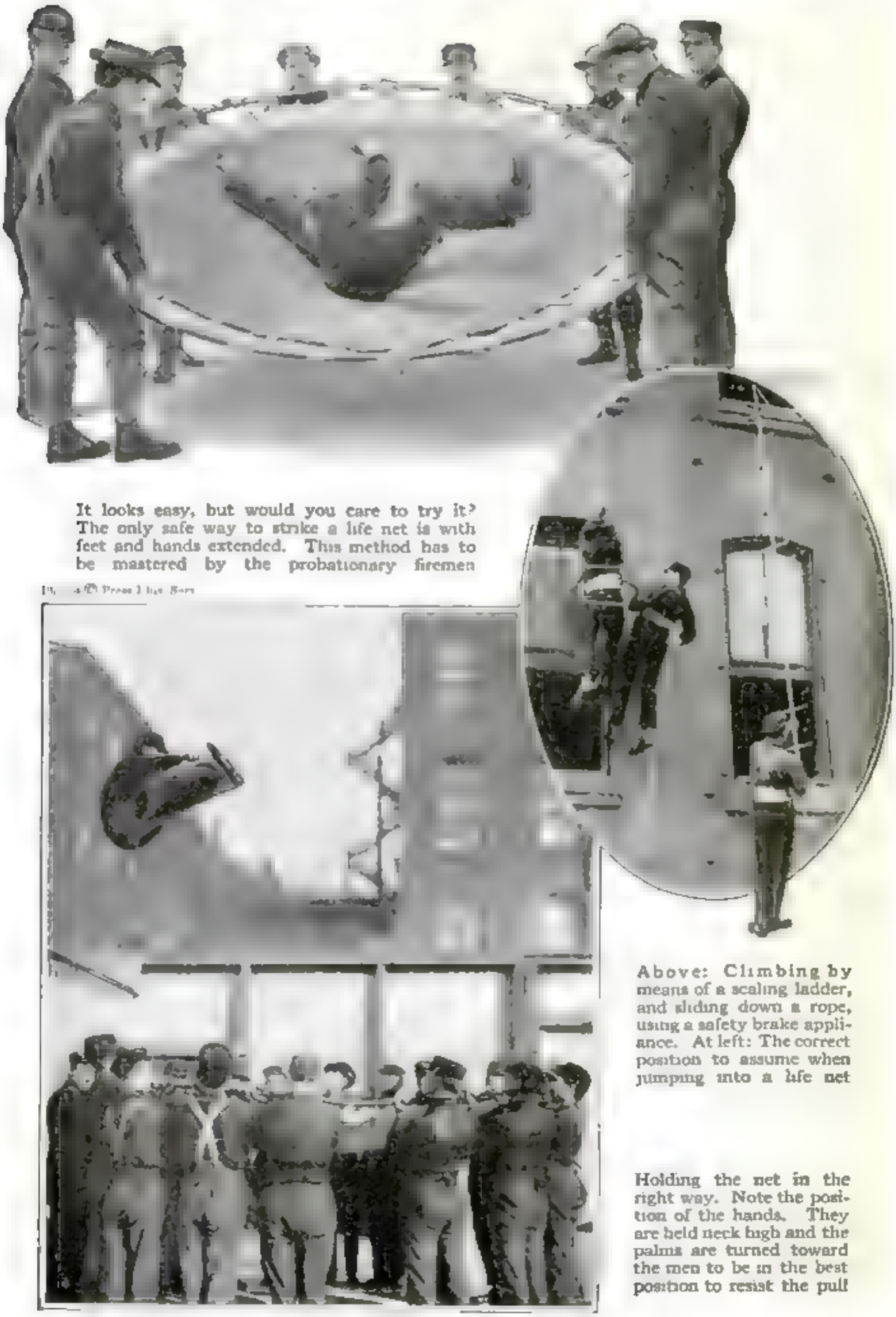
Below: Experienced women flag makers at work in the Navy Yard of New York City

Measuring and basting up flags on the floor. The method is laborious but it is the only one possible. The President's flag is pictured in the background

© Press Illus. Serv

A bird's-eye view of Salonika, photographed from an airplane. Among other things, this war has established the value of the airplane in reconnoitering work. Because the aviator equipped with a camera is able to photograph an enemy's territory, he is able to supply the general staff with information unobtainable by any other means. As a general rule stereoscopic pictures are the kind taken

New York Firemen Have Strenuous Training



It looks easy, but would you care to try it? The only safe way to strike a life net is with feet and hands extended. This method has to be mastered by the probationary firemen

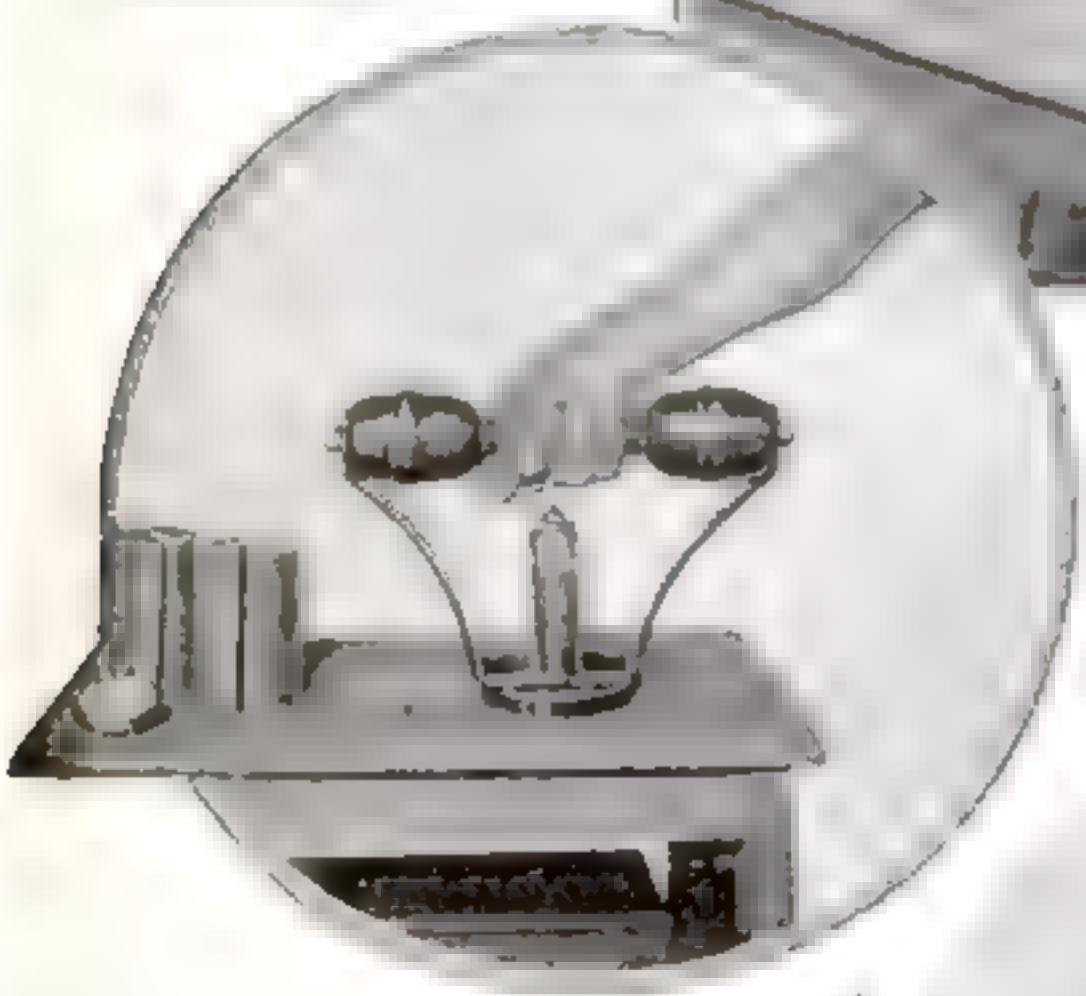
Above: Climbing by means of a scaling ladder, and sliding down a rope, using a safety brake appliance. At left: The correct position to assume when jumping into a life net

Holding the net in the right way. Note the position of the hands. They are held neck high and the palms are turned toward the men to be in the best position to resist the pull

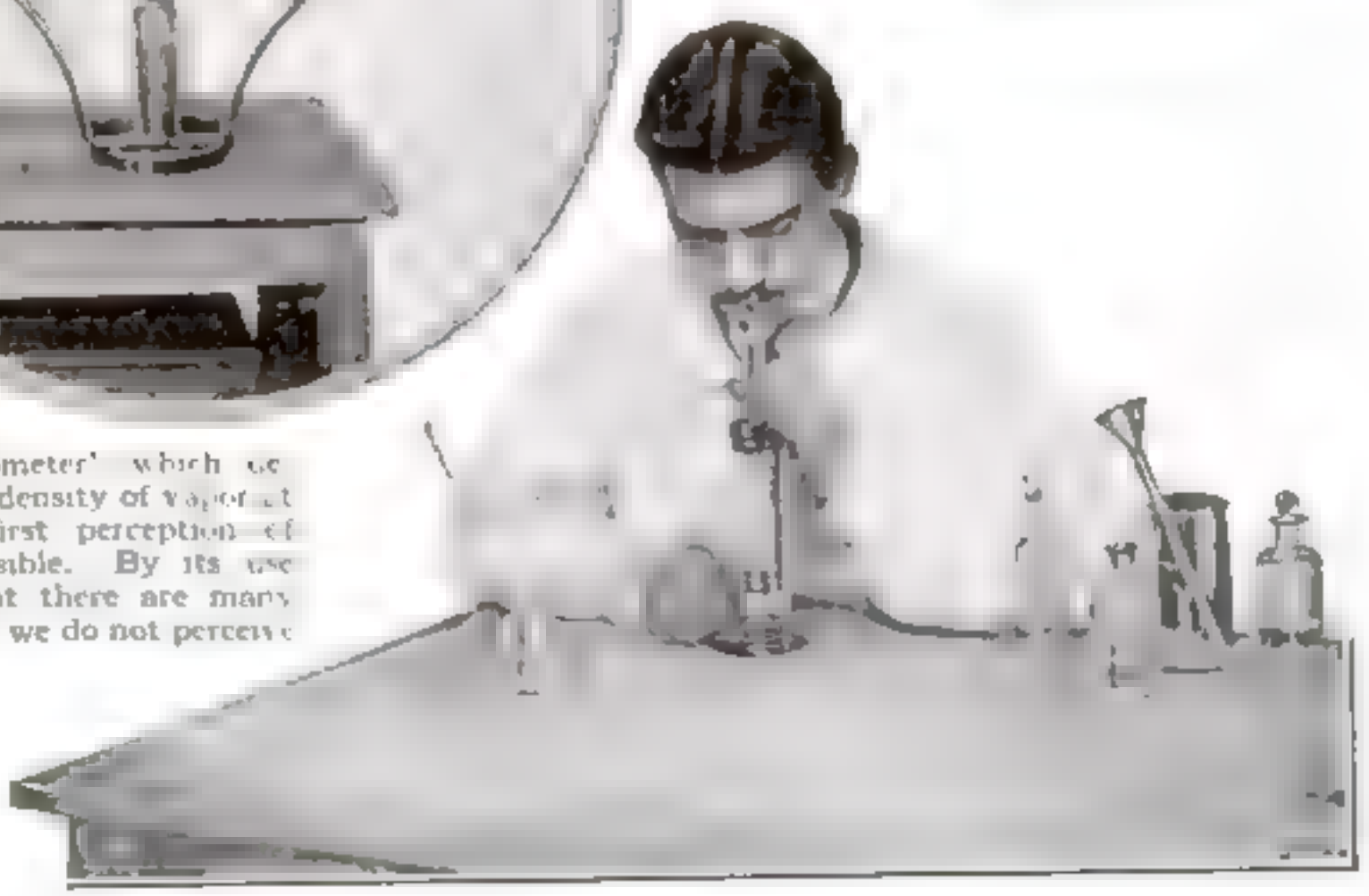
Tests Which Scientists Use to Show Why We Can

The eye is a kind of photographic camera. You don't always want a bright light when you photograph, and neither does the eye when it sees. A camera has a diaphragm which can be opened more or less to regulate the amount of light admitted, the eye has an iris which does the same automatically. But the eye can be fooled. In the picture the observer is looking through a lens at an object. When the object is moved farther away and the lens removed the iris opens to see better, and yet the intensity of the light has not changed and the widening of the iris is unnecessary

At left: An interesting test to prove to the human brain that the muscles can lift a greater load than seems possible. The load is increased very gradually

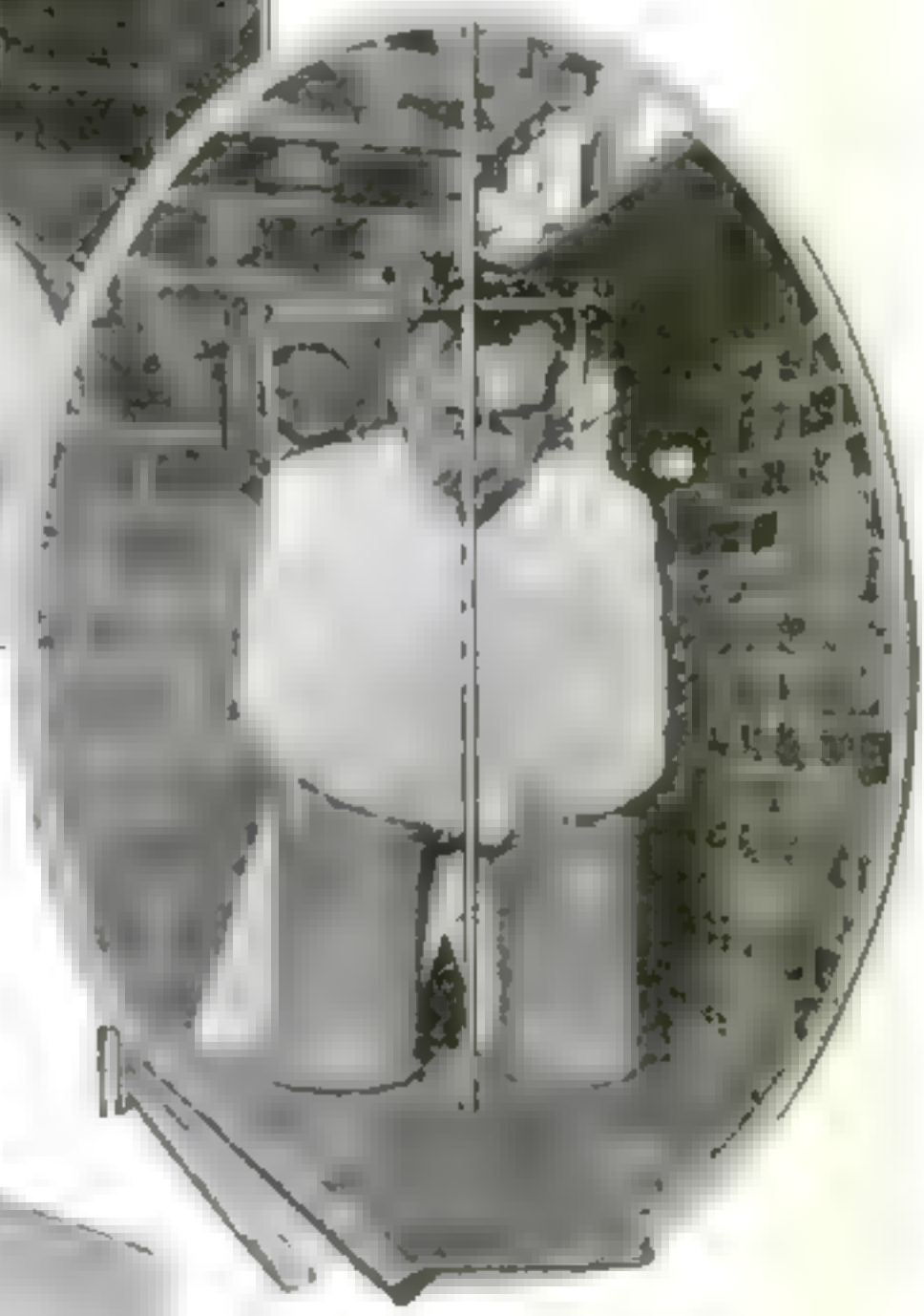


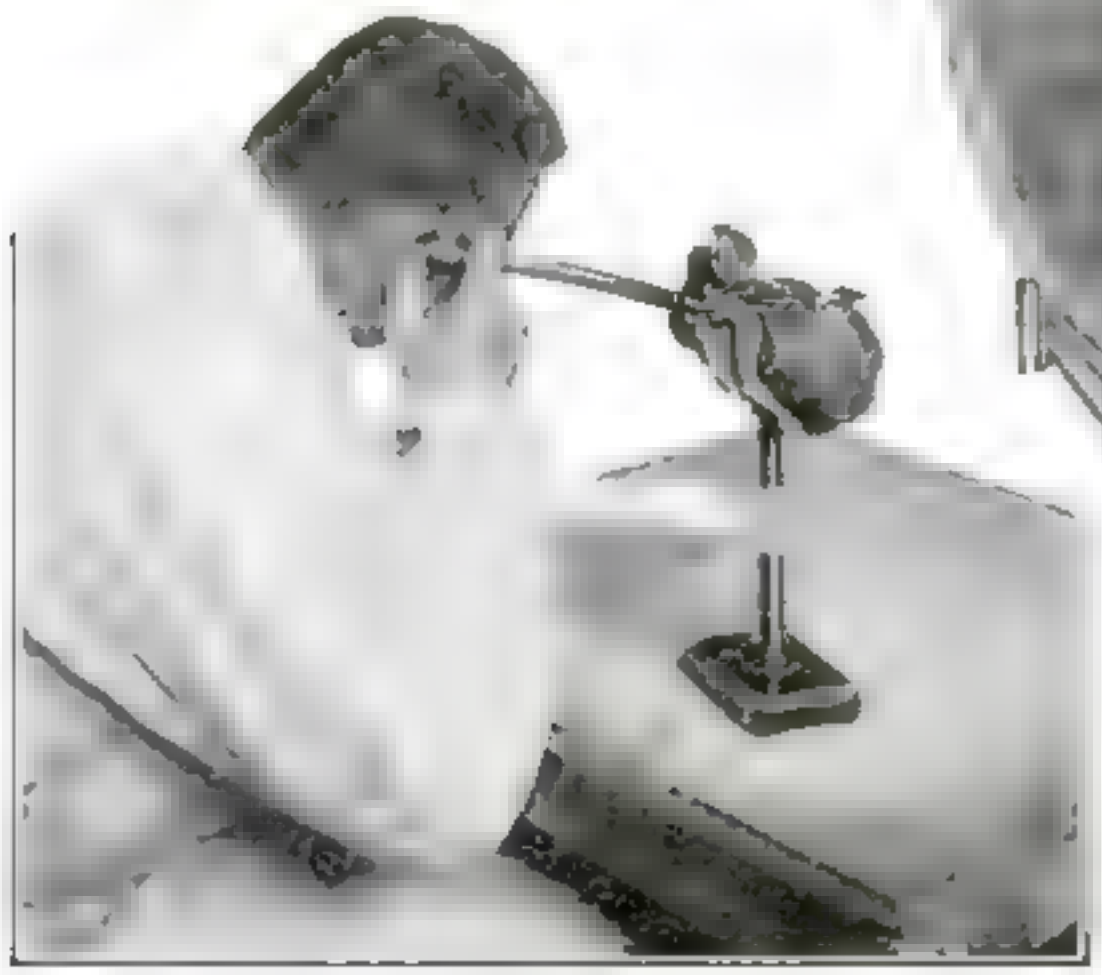
The "olfactometer" which determines the density of vapor at which the first perception of smell is possible. By its use we learn that there are many odors which we do not perceive



Not Always Believe Our Own Eyes and Ears

Another trick played on the eye is shown in the illustration at the left. A man looks through a lens at an object placed a short distance from it. The object is then moved farther away and the lens is removed. The brain realizes that the distance has been increased and here again the iris of the eye widens, even though the intensity of light was not altered





Acuteness of hearing is determined by varying the volume of sound let into the ear through an opening in a tube. For some people the full volume of sound may be audible through a tiny section of the opening while others get it only through the fully opened tube

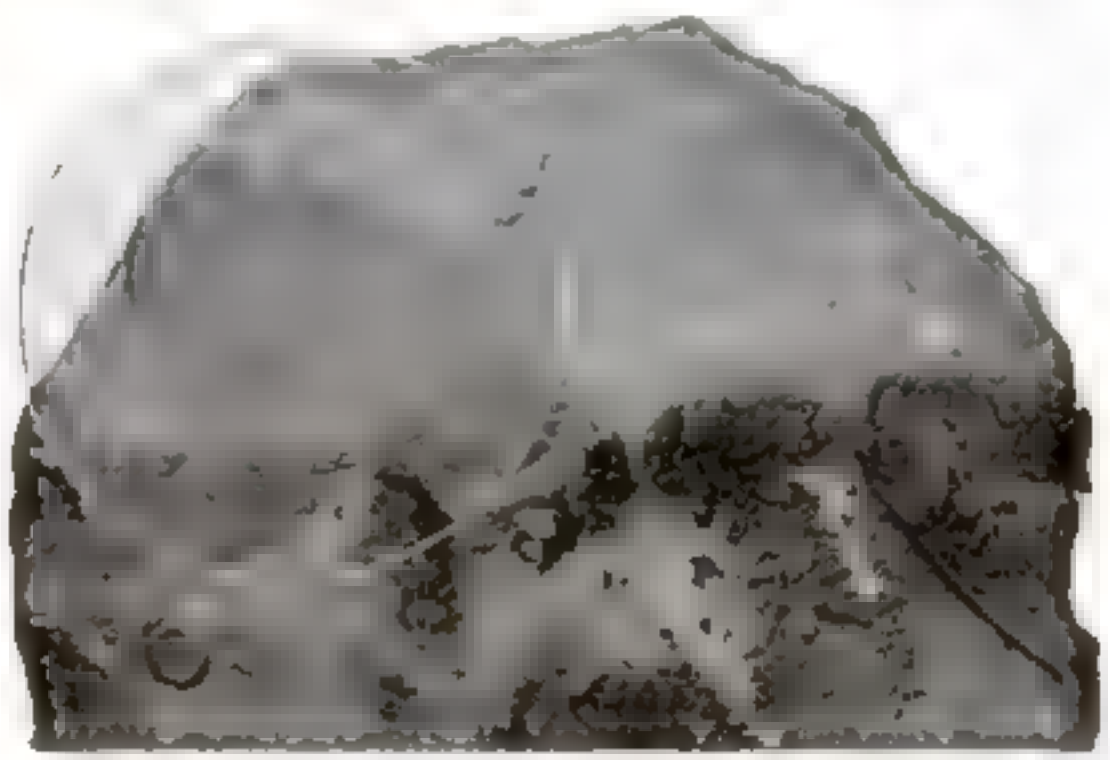
Your sensitiveness to temperature may be tested by placing your hands in two jars of water of different temperature. If the hands are crossed as in the picture above, it will be almost impossible to tell by the sense of feeling which hand is in the hot water and which in cold

Photos by Jacques Boyer

The Oldest Man-made Things in the World

The oldest canvas painting in the world, executed about 3,500 years ago, found in Upper Egypt by Robert de Rustafjaell. The paint work has fortunately been preserved in all its freshness

The oldest known sculpture represents a seated man clasping an oval-shaped vase. It is probably 7,000 years old and bears witness to primitive man's conception of beauty and manly grace



The finger imprint in the circle preserves to us the oldest evidence of man, estimated at 250,000 years

At left above is the earliest known painting of a Christian subject on canvas—the Saints Raphael, Michael and Gabriel. At right above are two baby shirts, the oldest known shirts

Improving on Man's "Natural Finish"

Tattooing is performed by puncturing the skin and introducing under it colored fluids to produce an indelible stain in a pattern

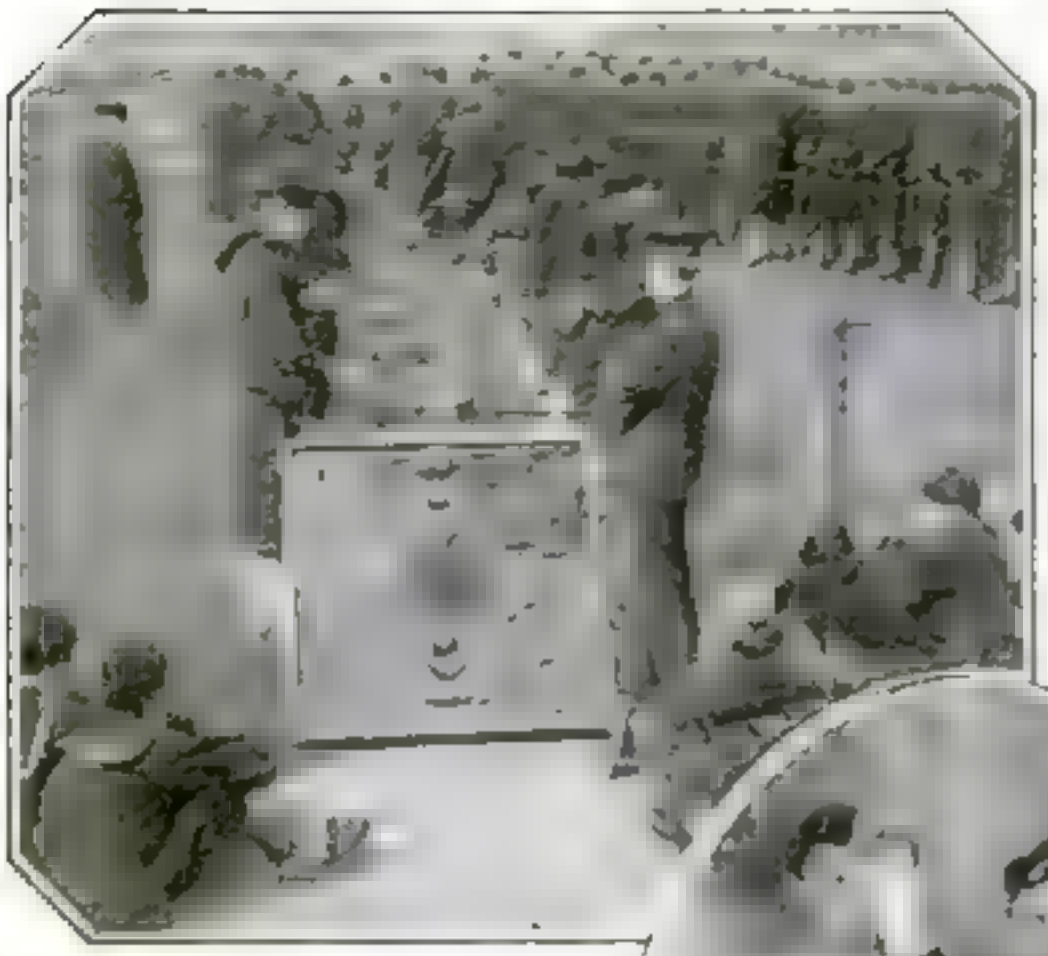
Goddess of the Night, tattooed by Sutherland MacDonald on the back of an Englishman. This seems too fine a specimen to be covered up

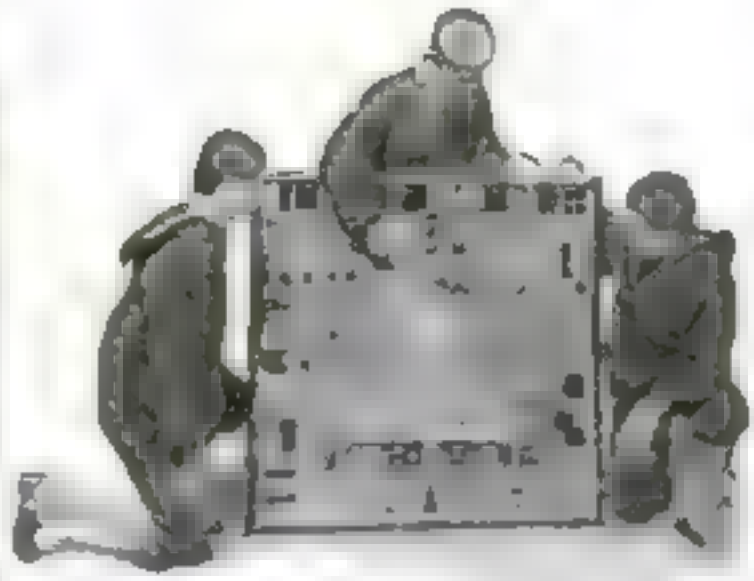
Above: An elaborate example of English tattooing—an eagle pursuing birds

Japanese tattooing executed by Hori Chyo, a celebrated exponent of the art

At right: Coat of Arms and motto tattooed on the arm of an English officer

Picking the Best in Brain and Brawn





Photos © Int. Film Serv

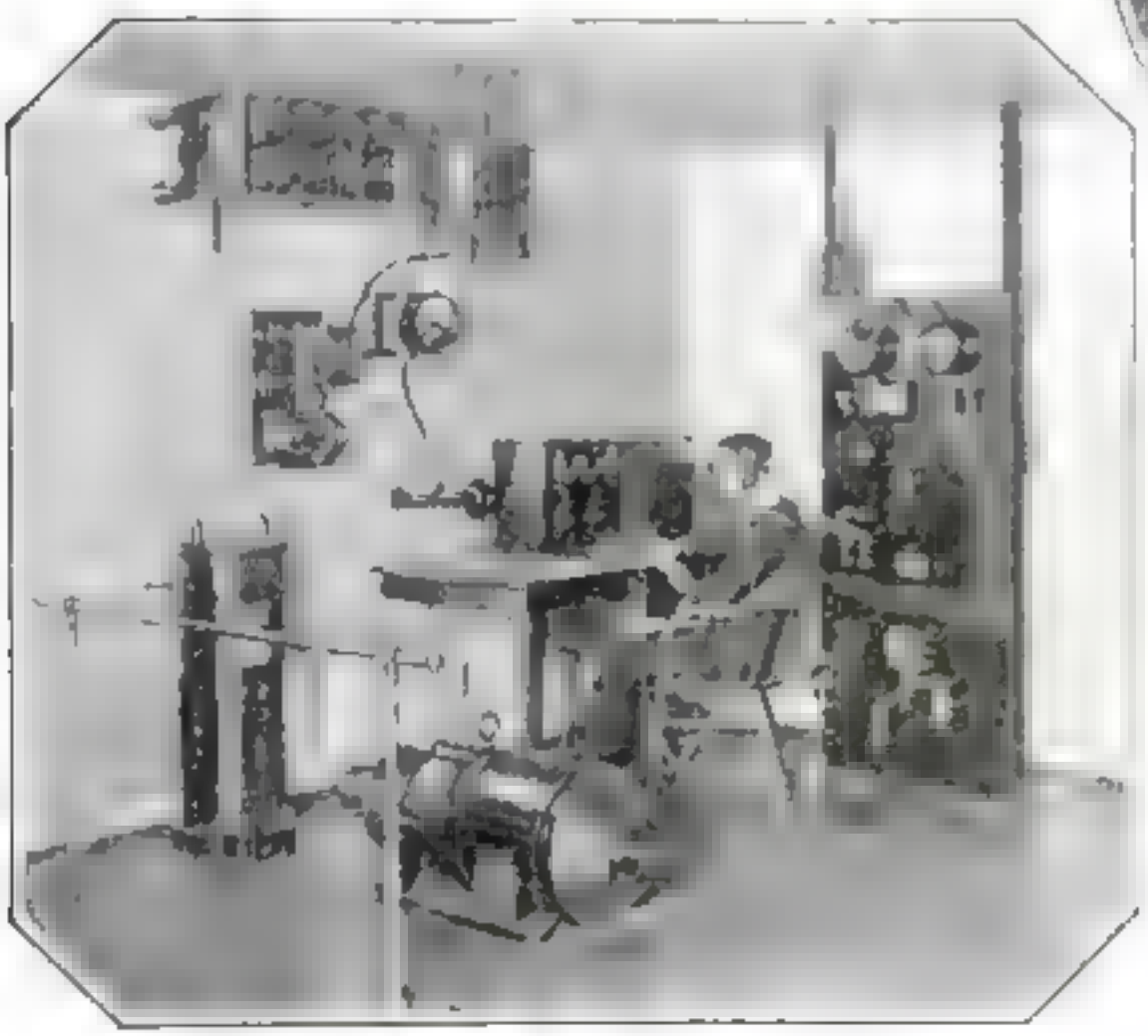
An officer explaining the significance of a battleship's hoist flags and how they are raised into position

Instructors teaching a class of young bluejackets how to tie and splice ropes. On the board are various examples of knots and splices, some of which are extremely difficult to master

A recruit undergoing the eye test. First one eye is examined and then the other. The sailor is operating a board containing letters of all sizes

A detachment of bluejackets, members of an artillery division, going through a field drill on board a man-of-war. Sham battles are carried on in deadly earnest

Taking the chest measurement of a recruit. He is a fine specimen, with a chest expansion of four inches. At right, the recruit picks out skeins of yarn that harmonize in color, to determine whether or not he is color blind



A blindfolded squad practicing overhead firing with the ordinary service rifle. Their targets are a fleet of imaginary enemy airplanes

The wireless telegraph room and equipment of a modern battleship. The operator performs a service which is of great importance to none

Making Motor-Car Bodies to Order

There are styles in automobile bodies just as there are in my lady's gowns Here the pattern plotters are shown at work

Wives of millionaires have car bodies built to order, with interior linings that can be changed whenever desired to match a gown

Above Setting up the body after the various parts have been cut to order. The next operation is to glue the parts securely together

Fitting the aluminum overcoat on the skeleton body of white ash The fit must be made absolutely perfect to withstand the vibration

A body, with its aluminum overcoat, turned upside down for a part of the fitting operation

Putting the finishing touches on a limousine body. None but an expert is trusted with this important task

Special workmen attaching the trimming and upholstery to a modern high-priced car

Killing the Dry Frog in the Opera Singer's Throat

Contrary to your first impression the figures in the first picture are not fortune-tellers but opera singers playing cards in an inhalation room. They are breathing the prepared air which is said to be beneficial to the throat. From right to left are Pasquale Amato and A. de Segurola. In oval: Taking the nasal douche. The singers are A. de Segurola and Pasquale Amato

The European Trenches Are Not the Only

Gas masks a new development? Hardly. They have been used for years in American industries. At the left a girl is shown putting caps on bottles of disinfectants

Foreign cotton has to be disinfected to k[illegible] the boll weevil. Here it is treated with hydrocyanic gas pumped at a pressure of 1[illegible]00 pounds a square inch. A whiff of the gas is fatal

Handling barrels of chloride of lime which gives off an irritating dust powder and chlorine gas, the destructive gas used in trench warfare. The men are well protected by their masks

Places Where Gas Masks Are Necessary

A gas mask worn by the photographer enables him to take a picture of the man who is shown at left below repairing a leak in an ammonia tank. During the time the photograph was taken choking fumes of ammonia were escaping in great volume from the tank, which is situated in a cold storage plant

Repairing the ammonia tank, a task made safer through the use of the gas mask. The cylinder below the mask contains chemicals which absorb all of the poisonous fumes and allow only pure air to reach the lungs

A chemist experimenting with a dangerous combination of chemicals which give off poisonous fumes. With the gas mask protecting his nostrils, he is able to approach close enough to his work to watch it intently

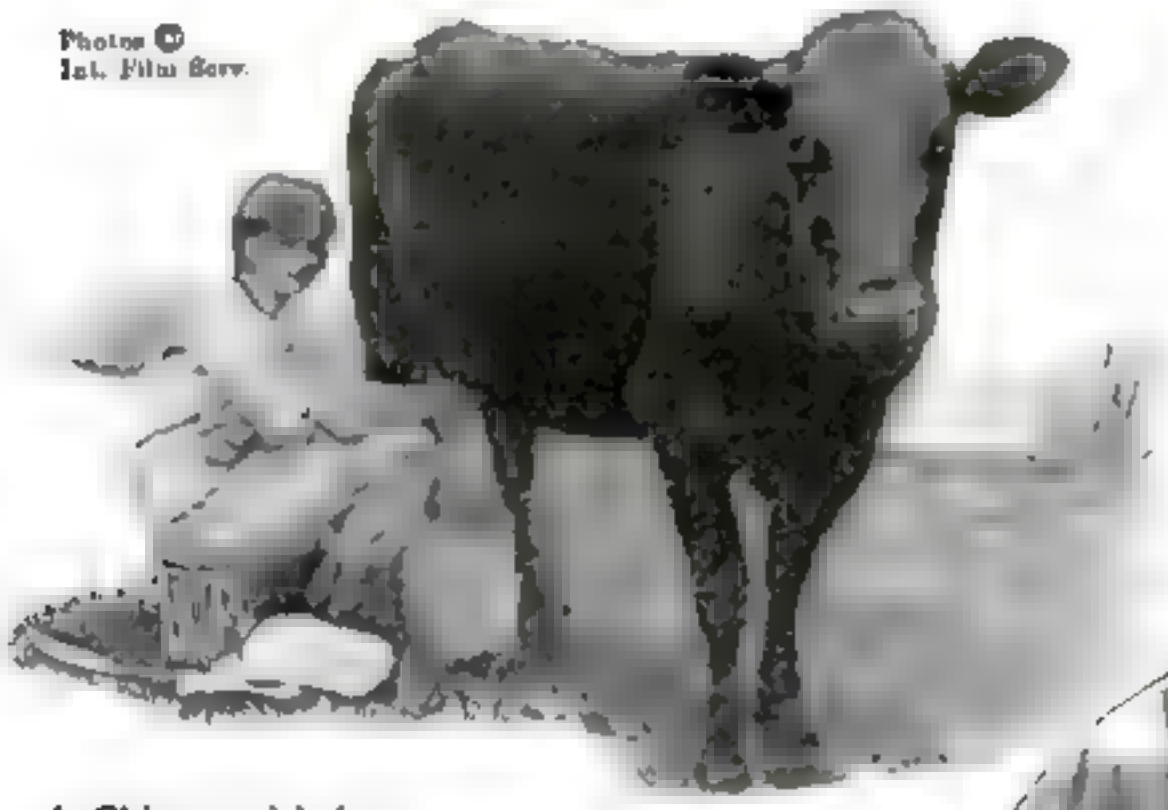
How the Stay-at-Homes Can Provide the Sinews

America turns to the soil in earnest. Even women are responding to the call for active service. Mrs. Ruth Litt, the wealthy suffragist, has turned over her 135 acre farm for cultivation, the work to be done entirely by women. The photograph below shows Mrs. Litt, Mrs. Grace Homer, Mrs. George Baxter, Jr., and Mrs. Charles Gould at work

Photo © by
Film Serv

Three hundred acres of land in East Potomac Park, Washington, were given over entirely to the Boy Scouts Brigades by the Government to be cultivated as a vegetable garden

Photos © Int. Film Serv.



Picture continued from opposite page. Citizens of Nyack, New York, leave their rifles at home temporarily and go forth to wage war against the soil with farmer's implements. The men are shown preparing the ground for garden products

A Chicago girl doing her farm bit to back up the nation's fighters. With six other girls she was transferred from her employer's office to his farm

The Rockland County Patriotic Society on their way to charge a ten-acre plot and convert it into a vegetable garden. They believe that the spade is as valuable as the rifle

Getting ready for a "hold-up" picture. The blackness of night is genuine but the lights are brought from the studio

The Poison Gases That Kill Men in Trench Warfare

WE do not know definitely the composition of the gases used in trench fighting. From the appearance, odor and effects on the men it is believed that a mixture of chlorine and bromine is employed with the possible addition of sulphur fumes or formaldehyde gas. Germany produces chlorine and bromine in large quantities. These gases attack the eyes, the lining of the mouth, throat and nose. One part of bromine or chlorine in one thousand parts of air produces almost instant death. The gases first cause a violent cough, followed by spitting of blood.

Making "Night Scenes" for the Motion Pictures

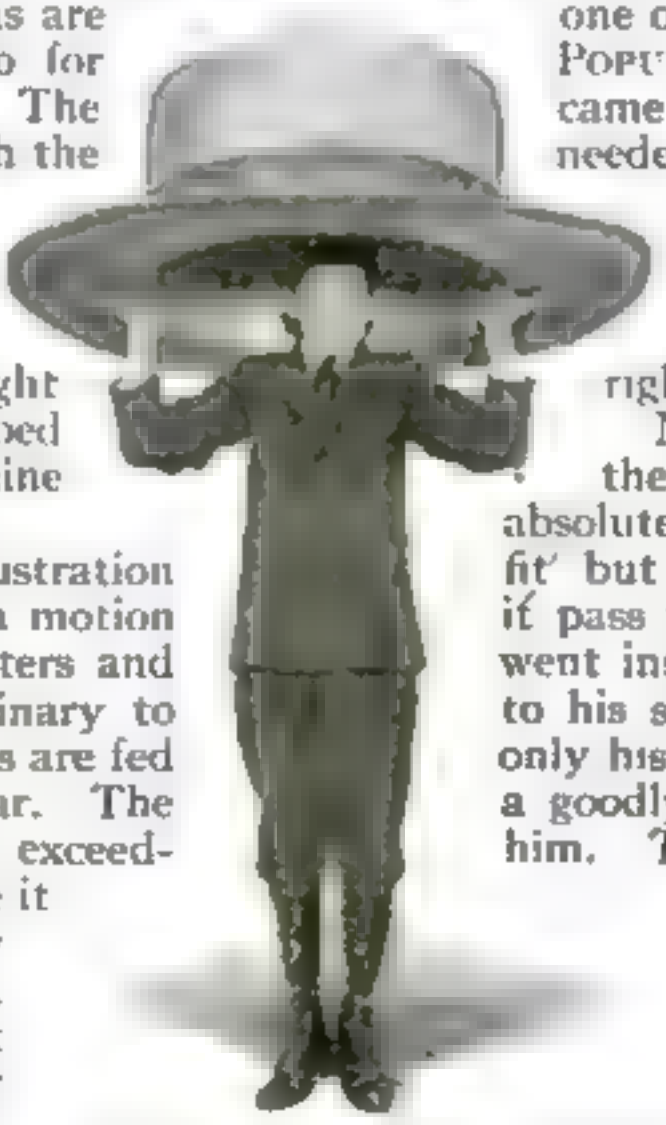
THE Limited is held up! Light from a switchman's lamp or from the highwaymen's bull's-eye illuminates the harrowing scene. Or so it appears on the screen at the motion picture theater. As a matter of fact the light is supplied by a semicircle of flaming arcs such as are used in the ordinary studio for "close-up" photographs. The only necessary feature which the studio cannot supply is the darkness. In order to get the realistic impression which marks the success of a picture, a night scene such as the one described must be taken in the genuine blackness of night.

The accompanying illustration shows the director of such a motion picture lining up his characters and adjusting the lights preliminary to taking the picture. The arcs are fed from the dynamo of the car. The light is very brilliant and is exceedingly hard on the eyes since it has to be flashed directly into the faces of the actors. For this reason such night scenes are not as popular with the performers as with the spectators.

The Largest Straw Hat in the World Is Yours If It Fits

IN the display window of a large hat manufacturing company in New York city the hat in the photograph below was recently placed on view, bearing the placard, "The Largest Hat in the World. If you can wear it it is yours." Immediately one of the editorial family of the POPULAR SCIENCE MONTHLY became interested. Perhaps he needed a new straw hat. He was too modest, however, to take the company at its word and step right in and claim the hat by right of head dimensions.

Not so the editor's mascot—the office boy. He was not absolutely sure that the hat would fit but he was unwilling to let it pass without a trial. Boldly he went inside and tried it on, finding to his surprise that it covered not only his head but his shoulders and a goodly portion of all the rest of him. Thus convinced against his will, he nevertheless, proved his ability to wear the hat long enough to pose for a photograph in it, or under it, though it required both hands for the task.

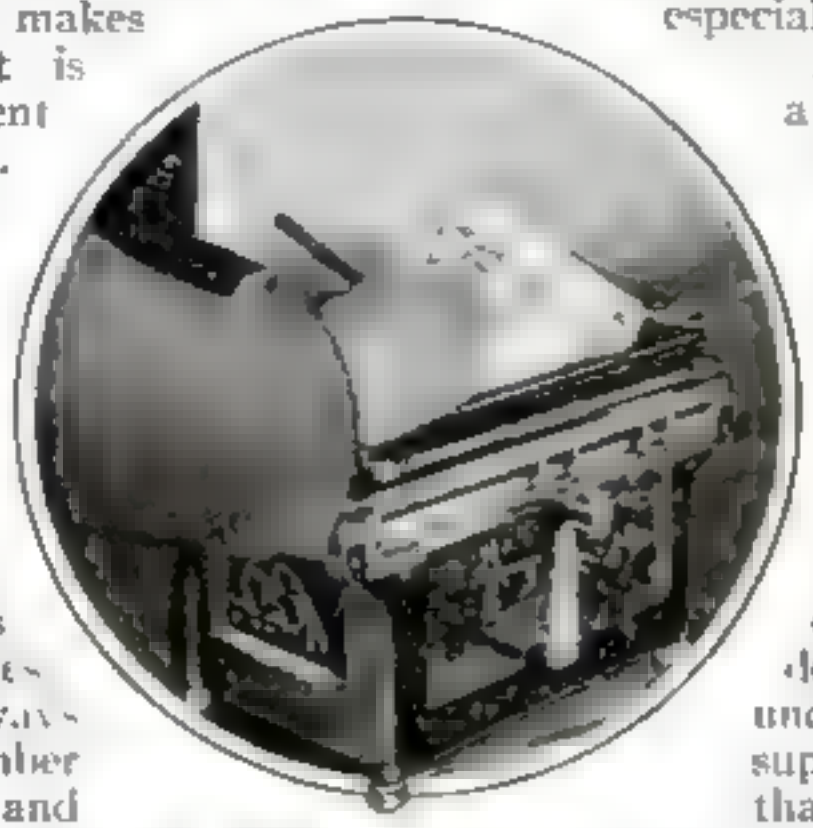


Joe, our office boy, posing with the largest straw hat in the world

How Fast Is Your Typist? This Ingenious Machine Will Time Her

INVENTORS have tried for years to put a counter on the typewriter to estimate the speed of the typist, but the efforts have always been confined to a count of the words written. A recently patented device, called a cyclometer, counts every stroke which the typist makes on the keyboard. It is fastened to the escapement wheel of the typewriter. This wheel does not move when the carriage is shoved backward and forward.

One firm employing fifty typists found that its work was below normal by cyclometer count and later that it had some very rapid typists and some very slow ones. The rate of pay had always been based on the number of years of service, and many of the slow ones were being paid for the work done by the rapid operators. This of course was quickly adjusted.



The timing device records not only the number of words written but the number of strokes made

The Grave-Digger Beetle—Nature's Sanitary Policeman

WHEN an animal dies in a garden or in the woods and decomposition begins, carrion bugs come from far and near. A dead bird, a mouse or a harmless snake wantonly killed by some wanderer provides a banquet for hundreds of insects. Among these the "grave-diggers" are found, embracing forty-three species, twelve of which are found in Europe, the rest in America.

You can identify these beetles by the two jagged yellowish-red or reddish transverse bands upon their black wing-covers. Their scientific name (Necrophorus) means no more than "buriers of the dead." As undertakers, the insects have legs especially adapted for digging. A grave-digger beetle has a most extraordinary sense of smell. He can detect the peculiar odor of decomposition a long distance away and flies to the dead thing as straight as an arrow. His remarkably keen nose is situated in his club-like feelers.

As a rule several grave-diggers are found near a dead body. They crawl under it and scratch the supporting earth away, so that the body soon lies in a hollow. Gradually the body is lowered until it sinks below the surface. Then it is covered with earth. The female lays her eggs around the interred form, thus insuring for the newly hatched larvae a plentiful food supply.

It is interesting to note that these grave-diggers can produce a curious creaking noise, by rubbing the fifth abdominal ring, which has two longitudinal projecting bars, on the under edge of both wing-covers. This noise is only made when the bug is attacked; it has therefore been considered an expedient to frighten away its enemies. Nature further fortifies the beetle with a general musk-like odor and by a particularly strong smelling juice which it exudes like a skunk if touched. This odor serves as a protection from human beings, especially, as it is peculiarly unpleasant and penetrating. If the beetle is handled it requires several washings to remove the odor from the fingers.

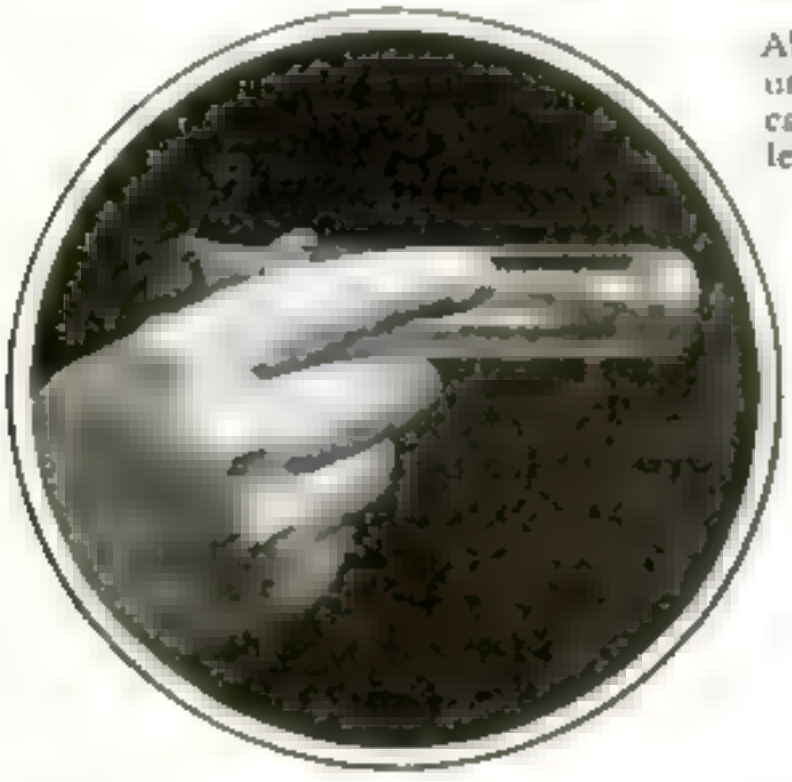
The grave-diggers are among the most useful of beetles. They have been designated Nature's sanitary police.—DR. E. BADE.

The beetles dig the earth away from under the dead body so that it sinks into its grave. Then they cover it over

How Scientists Capture Mosquitoes Alive for Experiment and Study

OCCASIONALLY it is necessary to do something else with a mosquito besides swatting it out of existence. In order to study the best methods of annihilating it, scientists, health officials and entomologists find it necessary to classify the insect, dissect it and experiment with it. For these purposes it is necessary to collect the mosquitoes without crushing them.

A collecting tube of any size may be used, but the one most approved is a glass or celluloid tube about five inches long and one inch in diameter. When in use one end of this tube is closed with a cork stopper and the other with a specially designed trap, the invention of Dr. T. H. D. Griffiths, of the Public Health Service, of New Orleans, La.



Above is shown a collector using the mosquito trap to catch live specimens. At left is the tube, natural size

The trap consists of a cork stopper to fit the tube. Into this a one-half inch central opening is bored to accommodate a small somewhat tapering glass tube, the outer end of which is one-half inch in diameter, diminishing to three-eighths inch in diameter at the opposite, or inner end.

When making a catch, the trap end of the tube is placed over the resting mosquito, which in attempting to escape selects the only way out, toward the light. This leads through the glass cone into the large collecting tube. The average time required for a catch is about three seconds. When the collection is made for laboratory use, not more than ten specimens should be taken in the tube at one time, lest the captives injure one another.

A Japanese Invents a Curling Iron

KANJI TANAKA, a Japanese residing in Seattle, Washington, has invented a curling iron, which is designed to make the hair-curling operation not only easier but more expeditiously performed. With it the hair may be curled and the iron taken out without the usual unwrapping process. This is supposed to leave the curl in better form.

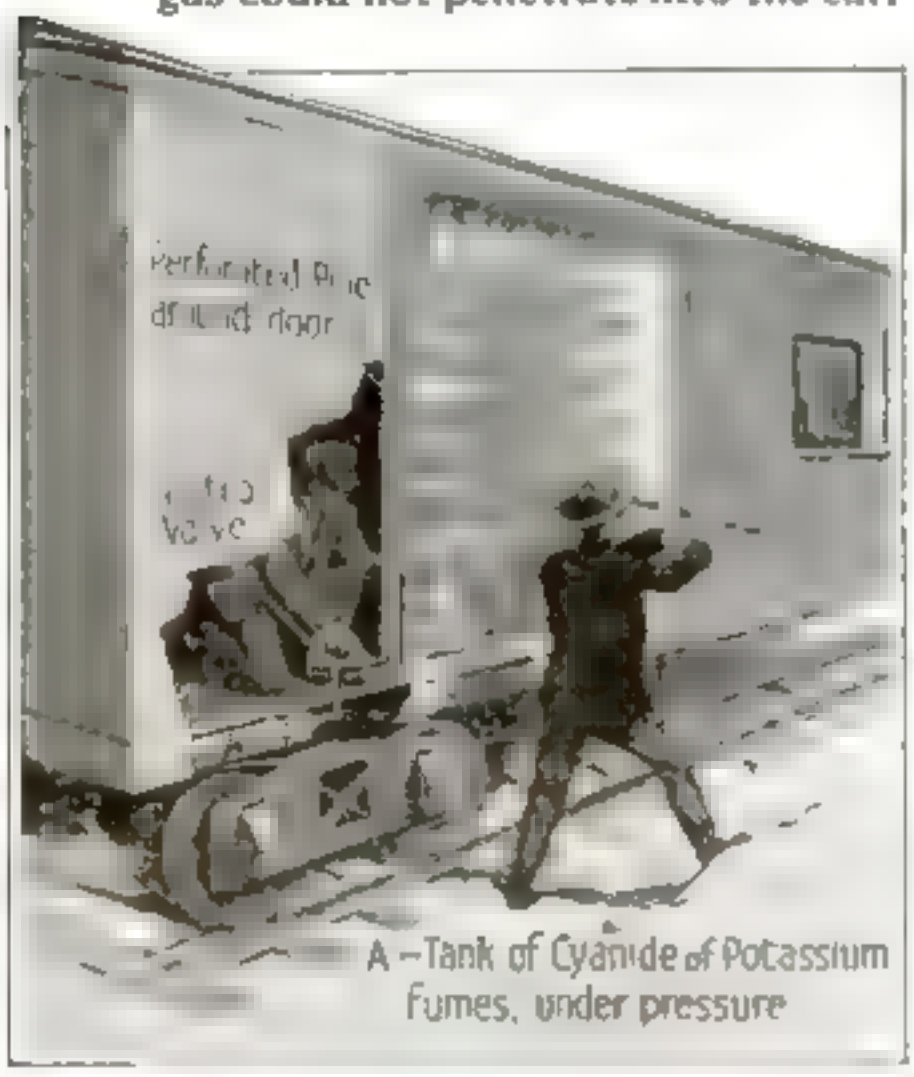
By pressing a kind of button the curling is done almost automatically. By another pressure the parts are unlocked so that they can be slipped out separately. Another advantage which Mr. Tanaka claims for his curling iron is that only one hand is required for the operation.

This curling iron is in two parts so that it can be slipped out of the curl in separate sections

Attacking Mail-Car Robbers with Deadly Fumes

IT would be a sad gang of robbers who tried to break into the railway car invented by George W. Meyers, of the United States Army. They would be greeted with clouds of poisonous gas fumes.

Meyers' robber-proof car works with extreme simplicity. Two tanks, in which fumes of cyanide of potassium are stored under pressure, are fitted inside of the car at each end. These are connected with a perforated pipe which extends all around the door of the car, just in back of the outer framework. Should the train be held up, the locomotive engineer would telephone the guards within the car, who would immediately open the valves of the tank. The fumes would stream out through the pipe perforations and into the robbers' faces. The door being gas-tight, the deadly gas could not penetrate into the car.



The deadly fumes are turned on from their tanks through the perforated pipe around the door

Making the Cow's Tail Behave with a Trolley Restrainer

The overhead trolley system and the fastener keep the cow's tail from annoying the milker

JOSUA AERNI and Joseph O. Venden, of Guler, Washington, have come to the rescue of the legion of tail-flogged milkers, with a device which makes the cow's tail behave.

Briefly, the device consists of a clamp, which holds the tail and an overhead trolley system which permits the holder to be moved from one cow to another. As the drawing shows, a rod is attached to the wire track in such a way that it can be readily moved and held in a rigid vertical position at the same time. At its lower end it is joined to the tail fastener by a flexible cord. The inventors do not take the trouble to describe their fastener, but it is evidently designed so that a strong spring grasps the tail.

Guinea Pigs Were Once Raised Like Chickens for Food

"THE cavy (guinea pig) is typically a pet animal, and has no other excuse for existence than the pleasure he gives those who appreciate his good qualities. . . . But it is to the undeniable edibility of the cavy that we owe the existence of the cheerful little squeaker of today.

"The Incas of Peru long ago domesticated the wild ancestor of the modern animals—a small, tailless, unicolored member of the genus *Cavix*, the exact identity of which is a matter of some doubt. These creatures were allowed to run freely about the homes of their owners, whose object in breeding them undoubtedly was for their food value

"The time which must undoubtedly have elapsed since this domestication was first begun is evident from the entirely changed color of the present-day cavy." (*Pets*, by Lee S. Crandall. Henry Holt & Co., New York.)

"Silent Music"—A Hospital Recreation

A wireless system conveys the melodies to those who want to hear without disturbing those who don't

Suffrage reports by wireless. The contrivance on the left is the receiving set with a few feet of "aerial"

Below: The telephone sending station By throwing a switch a voice transmitter is cut into the system to allow the operator to announce the record titles

A CHICAGO concern has come forward with a "silent music" contrivance that is designed to furnish recreation to inmates of hospitals. With this system installed in a hospital, a continuous and *noiseless* program of music can be furnished. Each patient may decide for himself or herself whether or not to listen, and if the decision is against such recreation, the patient is not disturbed in any manner.

Briefly stated, the mechanism consists of a phonograph attached to a telephone transmitter, which in turn is hooked up to an electrical wiring system that reaches each private room and each bed in the wards. At each wall outlet a watch-case telephone receiver is wired in. The patient desiring to hear the musical program simply lifts this receiver to his ear.

The sending station equipment is located at the office or in any convenient room, and consists, as stated, of an ordinary phonograph, electrically driven, holding the turntable, which carries any disk record. Attached to this machine is a special music transmitter, consisting of a combination of a telephone transmitter with a vibrating diaphragm and needle. The needle, following the groove of the record, energizes the diaphragm of the transmitter, which in turn energizes the telephone attached thereto.

Beside the transmitting apparatus is a control box, containing electrical resistances, which energize the transmitting apparatus properly, and binding posts for all connections.

By throwing a switch, a voice transmitter is cut into the system. This enables the operator to announce the names of the records about to be played, to give baseball scores, recitations, war news, and whatever other items may be of interest to his telephone clientele.

Except when this voice transmitter is being used, there is no noise of any description connected with the sending apparatus beyond a light scratching of the needle, for no tone arm or horn is used.

When installing this system in hospitals in the course of erection, the wiring is made to connect the sending station equipment with outlet jacks at the bedsides. These outlets are all connected in multiple on a single pair of wires, carried along with the regular telephone or signal system.

Dickory, Dickory, Dock, the Mouse Ran up the—Clock

WHERE are the creepy spiders, the mechanical beetles, and the spring-operated bugs which used to be the delight of the office boys and the terror of the stenographers? And surely the mouse has lost none of its effectiveness as a scream-producer.

A Frenchman has devised a magic wand with a celluloid mouse attached which is capable of great activity. It is worked by the action of a concealed magnet, so that the mouse appears to run up or down the wand in a mysterious way. The wand is a square tube of light wood covered with silk. The celluloid mouse has a small piece of iron on the bottom which is attracted by the magnet. When the wand is turned up a small lead weight on an endless cord falls and draws along the magnet which, in turn, takes the mouse with it. When the rod is tipped the mouse climbs up realistically.

In the photograph the silk covering of the wand is broken away to show the interior mechanism.

The celluloid mouse runs up the rod by magnetic attraction

These Magnifying Glasses Are Worn Like Spectacles

THE field of usefulness of the binocular magnifier, shown in the illustration on the right, includes the scientific laboratory, the medical office or hospital, and the workrooms of botanists, metal workers, watchmakers, etc. An elastic headband fastens it on so that both hands are free. The eye-pieces of vulcanite are fitted with lenses in such a way that the fields of view are brought within small divergent angles.

A small incandescent lamp fitted with a reflector and condensing lens may be fastened over the top, current being supplied from a battery carried in the pocket.

Both eyes are used with this glass, so that the object examined is seen in natural perspective

Why You Can't Compare Ships According to Tonnage

THE different uses of tonnage terms when speaking of ships are causes of confusion to the lay mind. For example, steamship companies in order to impress upon the traveling public the size, and consequent relative safety of their craft, will advertise the sailing of a certain steamer of twenty-thousand tons, meaning, of course, gross tons. The company's agent, in entering her at the custom house, will take great precaution to certify that she is of only 7,340 tons, when paying tonnage taxes. He then is referring to her net tonnage, and in fact that standard is used only when paying dues or taxes.

Displacement tonnage is almost exclusively applied to warships as they do not carry cargoes. Strange to say, the tonnage of a battleship varies almost hourly, as coal or other weighty objects are used or taken on board. The tonnage of warships is, however, fixed; they are referred to in terms of the fixed tonnage.

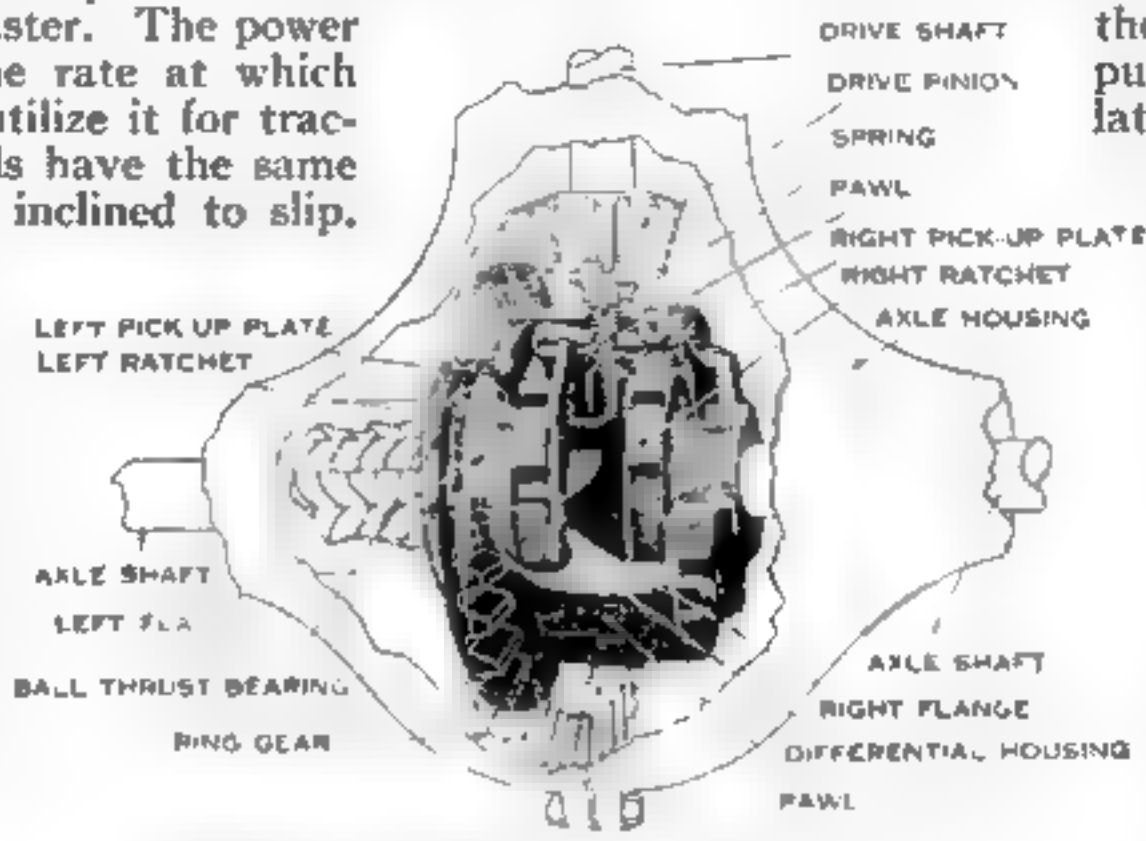
A statement that a ten-thousand ton battleship sank a ten-thousand ton merchant ship does not mean that the ships were of equal size. The merchant ship would be much the larger owing to the different meanings of the term "ton," as applied to the two types of vessels. It is absolutely impossible to give rules for the relations of these terms, as the conditions vary too greatly. Generally speaking, the gross tonnage of a ship is from fifty to one hundred per cent greater than the net tonnage. Tons displacement are always in excess of tons gross; deadweight tonnage is on an average from thirty to fifty per cent greater than gross tonnage.—CAPT. C. A. MCALLISTER, Engineer-in-Chief, U. S. Coast Guard.

Differentials for Motor Vehicles

Comparisons which illustrate the merits of various types

By Marius C. Krarup

THE Bailey is the name of a new differential gear for motor vehicles. It transmits power to both driving-wheels when these can rotate at the same speed, but only to one wheel when the other runs faster. The power is divided at the rate at which the wheels can utilize it for traction if the wheels have the same speed but one is inclined to slip. Traction from one of the wheels is thus sacrificed on all curves, whether the going is good or not, in order to concentrate power and traction on one of the wheels when traction from the other is lost for lack of friction with the road surface from slippery mud or snow.



A differential which concentrates power on one wheel when the other has lost traction on a bad road

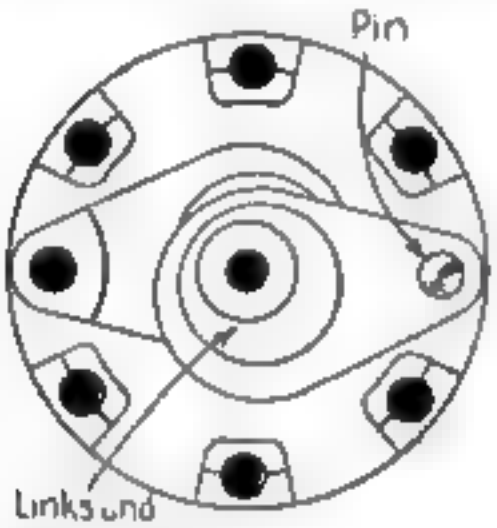
The casing is rotated by a bevel gear or worm drive, as usual. To the casing are secured two heavy pawls, of which one holds the left and the other the right wheelshaft by engaging notched disks fixed upon the ends of the shafts. The pawls are pressed against ball-pivots by coil springs. Their seats in the disks are shaped so as to make the engagement hold in either direction of movement, for backward as well as forward driving, but if one of the disks is forced around by the road contact of its wheel faster than the casing and the pawl are rotated by the power, this movement is permitted by means of a cam plate that lifts the pawl out of its seat. This action seems to be as follows: The pair of cam plates is mounted on a sleeve as a rigid unit that turns around with the casing, and opposite to each pawl one of the plates has a semi-circular recess that limits sideways turning of the pawl on its ball pivot, while the other plate here has a straight-line contour passing obliquely under the active end of the pawl but coming to a point directly before it. This gives the lifting action.

When both pawls drive, they stand at right angles transversely, balanced one against the other, but when one of the disks, actuated from the road, begins to push its pawl, the latter begins to turn a little on its pivot, allowing the disk the same small movement, and thereby the relatively immovable cam plate gets a higher point of support under the pawl, raising it and permitting the disk further unhindered rotation.

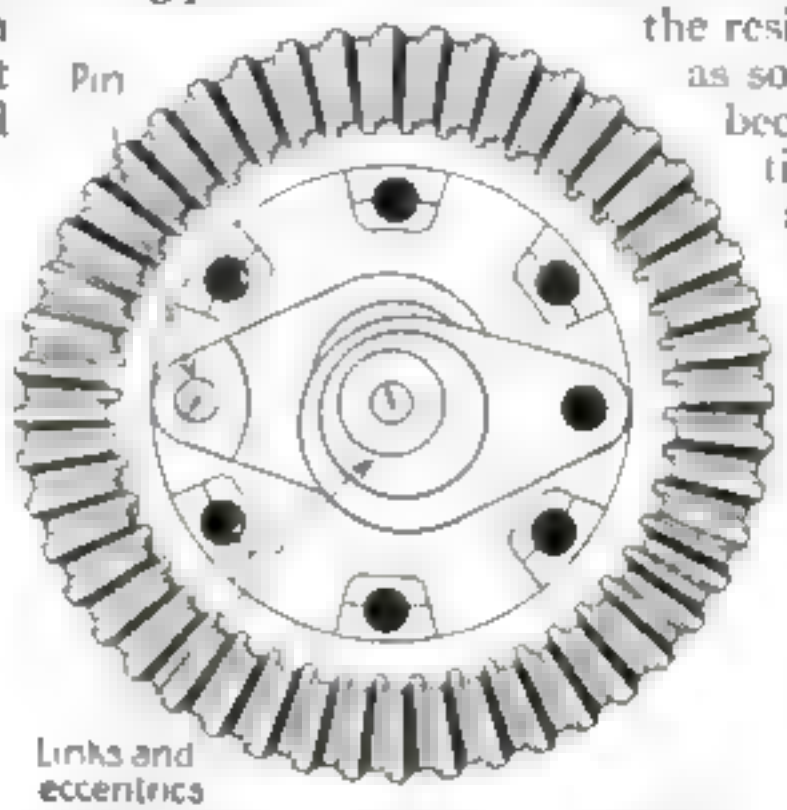
A comparison with other differentials illustrates the merits of each. In the ordinary balance gear differential of the type still used in a majority of motor vehicles the four small bevel pinions revolve on the plan of freely balancing the pressures on all teeth engaged. The engine power turns the casing which carries with it the two pivot pins on which two of the pinions are mounted. The two wheelshaft pinions, each in mesh with both of the power-transmitting pinions, can conform with the turning of the casing by revolving, taking the wheelshafts with them. If one wheelshaft resists as much as the other, one side of the actuating pinions is resisted as much as the other, and these pinions remain balanced and unmoved in relation to their pins. The teeth engaged become mere lugs gripping the wheelshaft pinions and forcing them to follow, by revolving. But, the moment one wheelshaft resists more than the other, from any cause whatsoever, the pressure on the teeth on one side of the actuating pinions becomes greater than that on the other side. These pinions are no longer

balanced. They begin to revolve on their pins, toward the low-pressure side. The high-pressure side of them no longer carries its wheelshaft pinion around unyieldingly. It lags till pressures are equalized, the wheelshaft with the higher resistance turning more slowly and the other wheelshaft more rapidly in the same proportion. The total of power utilized remains unchanged, except that a portion of it is spent in overcoming the friction of the revolving pinions.

As friction adds tooth pressure on both sides, it may be purposely increased to modify the action of the differential. For example, if the power delivered to the casing has a numerical value of 8 and the resistance of each shaft against rotation at a certain velocity is 4, no friction in the differential arises. But when road contact interferes and one of the shafts produces increased resistance at this velocity but only 4 at a velocity 33⅓ per cent higher, while the other shaft produces 4 at a velocity 33⅓ per cent lower, such as may be the case when a vehicle is made to turn on a fairly sharp curve, one shaft is turned twice as fast as the other and a certain friction is produced. In the ordinary differential this friction is negligible; but suppose it is made to have a value of 2, then there is only a power of 6 available, and there is less than 4 for each wheelshaft. The vehicle speed is reduced or more power must be turned on. Suppose, further, that one wheelshaft resists very little and does not equalize tooth pressures until it is revolved eight times as fast as the other. Then the differential works four times as much as before and the value of the friction rises rapidly, perhaps from 2 to 8. The power is consumed. By arranging the friction on a less drastic scale, however, one can have a shaft which offers a rather small resistance under small differential action, yet equals the resistance of the other shaft as soon as its rotary velocity becomes only two or three times as high, after which no greater difference in shaft speed can be produced. The power is then divided somewhat on this plan: 2 for the slow shaft, 1 for the small friction identified with its side of the differential action, 4 for the friction of the rapid shaft and 1 for driving it. If the wheel of the rapid shaft has no traction, there is still a net power of 2 for driving.



An eccentric can drive a link in and out but cannot be rotated by turning the link around



It is built strong enough to resist the stresses that arise in its operation

A Refrigerator Basket for the Picnic Outing

ALL the luxuries of home are now at the disposal of the vacationist starting off for a picnic at the beach or in the woods. The increasing vogue of automobile touring trips has also created a demand for portable creature comforts. A refrigerator basket is a refrigerator in miniature, which keeps the butter hard, the meat fresh and the milk sweet. It consists of a rust-proof metal food container with a smaller ice compartment partitioned off at one end. Around this shell is a layer of insulating material to keep the cold air in and the warm air out. Externally the carrier is a reed basket with convenient handles and straps to bind the lids down. Separate lids are provided for the two compartments.

The refrigerator-basket is the picnic party's ice-box. In it all perishable food is preserved

The Strength of Human Wings

One hundred and twenty-two people can stand on the wings of a big biplane

IF the men who lost their lives in the early years of the flying machine's development could come back to life and gaze upon the picture which accompanies this article, they would first gasp in astonishment and then they would approve enthusiastically the construction which made it possible for sixty people to crowd upon one-half of a huge biplane's wings without breaking them. For, let it never be forgotten, that some of the early martyrs who dropped to a terrible death from great heights, went to their doom because the builders of their machines had no conception of the structural strength required to buffet turbulent winds at high speed.

Study the picture well. Note that the wing section of a biplane here depicted is supported from a heavy wooden frame and not from the floor. The wing section is held only on one side and extends freely from that side into the air. Judging from their size, the wings are those of any enormous flying yacht. Although the supporting surfaces of this yacht could evidently sustain the weight of some one hundred and twenty-six passengers, they have not, of course, that amount of lifting power. The crew of the vessel probably amounts to four. Hence, the weight for one hundred and twenty-two people is available for the boat body, rudders, engines, propellers and supplies, something like over eight and one-half tons. Moreover, the human freight here pictured clearly does not overstrain the wings.

The picture is an object lesson in reserve strength. The stoutest storm-sails of an old-fashioned sailing ship were never subjected to such strains as those which must be endured by that fabric of linen, wires, and lattice-work of which the wings of a modern flying-machine are composed. A sail needs strength to resist mere tearing alone. A flying-machine's wings must in addition be so rigid that they will keep its shape in the worst hurricane. Only the pilot of an airplane knows how his wings are strained when he drops at a steep angle from a height of five thousand feet in a swift downward glide for home. It must bend no more than if it were made of cast iron. To this stiffness the modern airplane owes its superior stability.

Testing the wings of the great biplane by crowding upon it a maximum human load

Lost in New York? Consult an Electrified Street Directory

THE man from Oshkosh or Paducah can easily find his way around New York city if he happens to stop at one of the thirteen hotels there which have installed the electric directory. He can find the location of any building, street, or carline by pushing an electric button on the keyboard, for the location he is seeking will be illuminated by a little six-volt incandescent lamp.

The directory board is sixteen square feet in area and the map is divided into fifty-six sections for the city of greater New York. The current for the board is furnished by storage batteries.

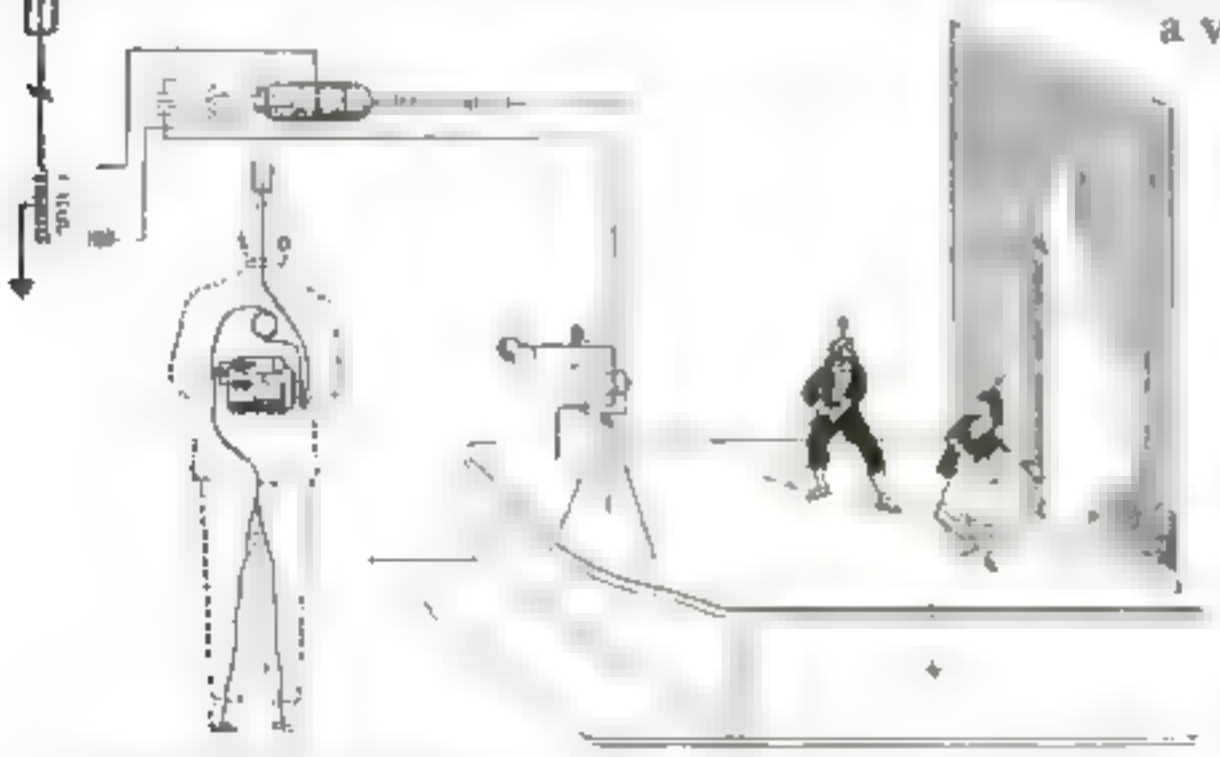
When the right button is pushed the desired location flashes into view

Taking Records of Sounds by Wireless for Talking Motion Pictures

THE problem of making talking motion pictures has been attacked by many inventors, but no more ingenious suggestion than that of Mr. William B. Vansize has been brought out. According to Mr. Vansize's plan, each actor is equipped with a tiny wireless telephone transmitter, and his speech is sent through the ether by "radio" to a receiving station which is connected with the phonograph. The receiving station may be located some distance from the actors and camera, so that as the people move about the stage their distances from the radio receiver will remain relatively unchanged and their words will always be heard at about the same strength.

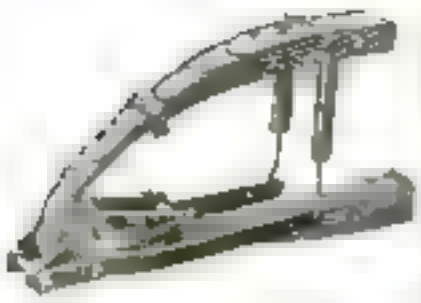
An oscillating vacuum tube will supply the necessary high frequency current, and the batteries used to run it may be made of very small size. A ground connection is secured through contacts placed on the soles of the actor's shoes and arranged to touch a metal plate on the stage; the diminutive aerial required may be constructed of a few thin wires projecting upward a foot or two above the actor's head, or may merely be a sheet of thin metal foil fastened across his shoulders under his coat. The microphone transmitter which his voice operates need not be visible, for it has long been known that the vibrations of one's chest are amply strong enough to operate a telephone transmitter held over the lungs.

The wireless waves sent out by each actor's radio telephone transmitter pass over the space separating the stage from the receiving station, which may be several thousand feet away, and there affect a very sensitive wireless detector. This instrument converts the speech waves into telephone currents, which are carried back to the recording phonograph by a wire telephone line. The sound-recording instrument may be either a magnetically controlled wax cylinder phonograph or a "telegraphone," which latter uses a thin steel wire instead of a soft cylinder or disk, and makes its sound records magnetically. Whatever type of recorder is used, it is mechanically connected with the moving picture camera.

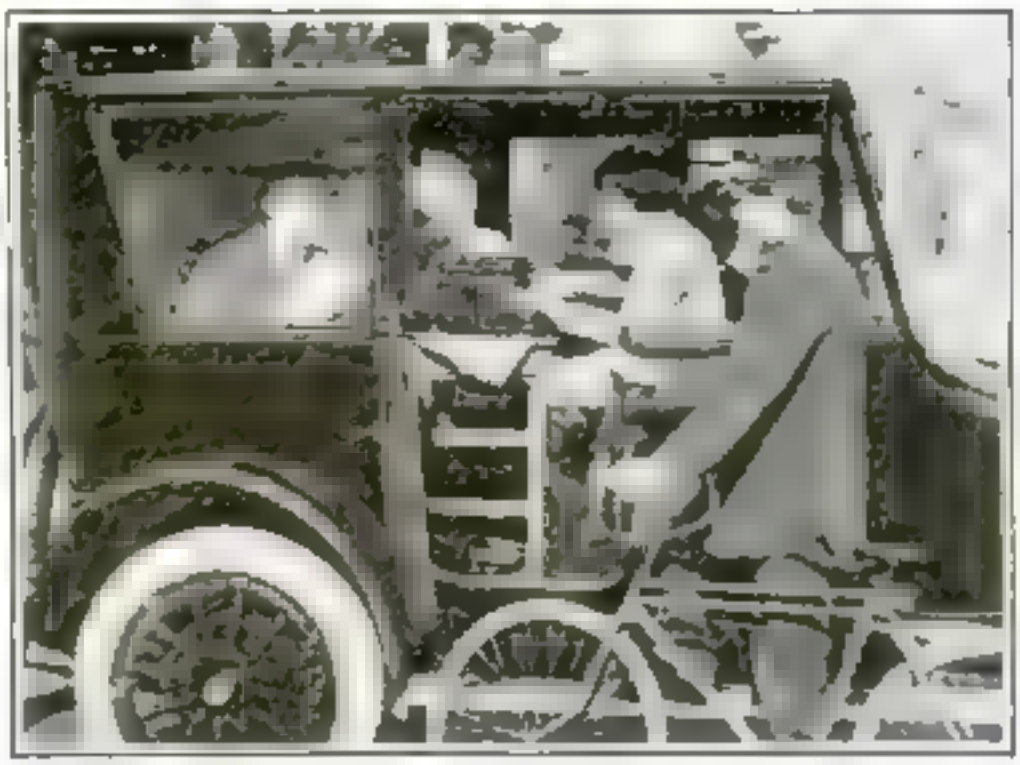


The wiring diagram of the apparatus which is worn by the actor. An oscillating vacuum tube supplies high-frequency current

The Newest Automobile Conveniences

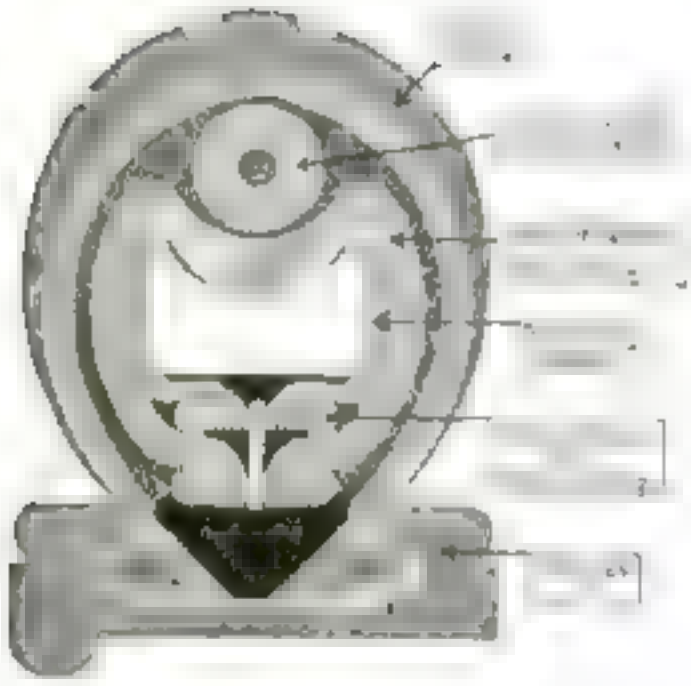


A new shock absorber which takes up shocks before they reach the car springs and the body of the car



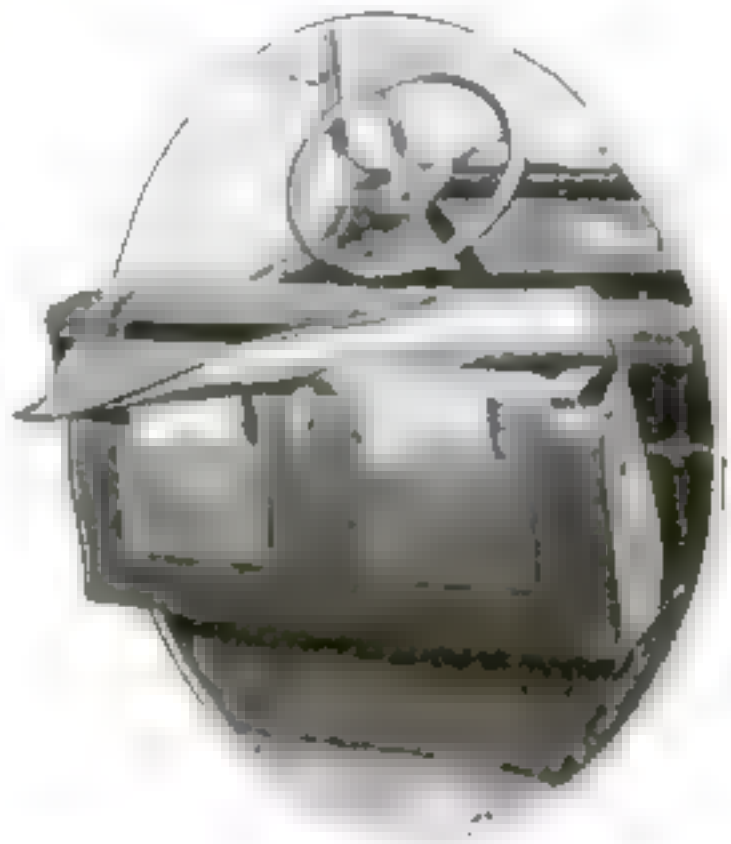
The man who is pressed for time has his car fitted up with a disappearing desk and typewriter

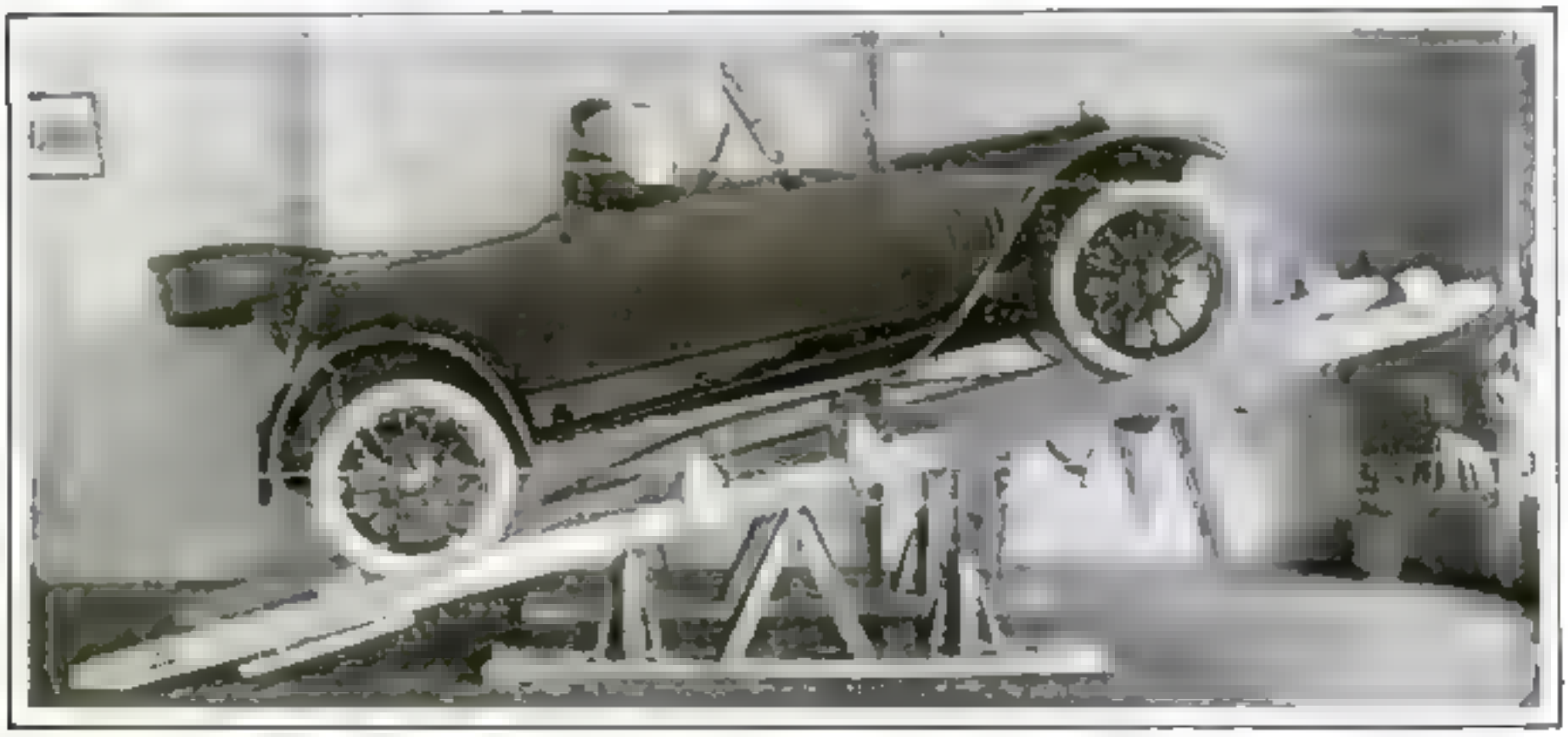
A plate or truss which provides a temporary repair for a broken spring. It supports the break longitudinally



A spring cushion tire to eliminate blowouts. The inner tube is a series of heart-shaped springs

A convenient luggage carrier strapped to the rear of the front seat. It is about three feet long





An automatic lift which enables the autoist to "get out and get under" without lying on his back. The car is run on to the lift under its own power. The lift is both demountable and portable

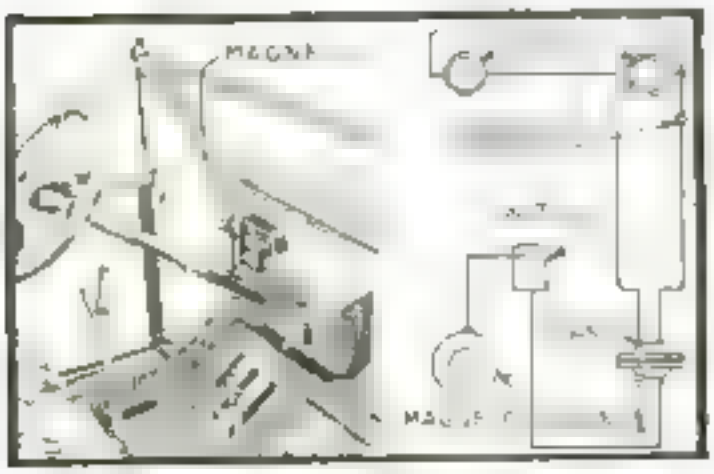
Labor-Saving Automobile Attachments

Two trucks, one backing up while the other went ahead, moved this house seven miles across country in a few hours. By old methods of house moving the job would have taken weeks

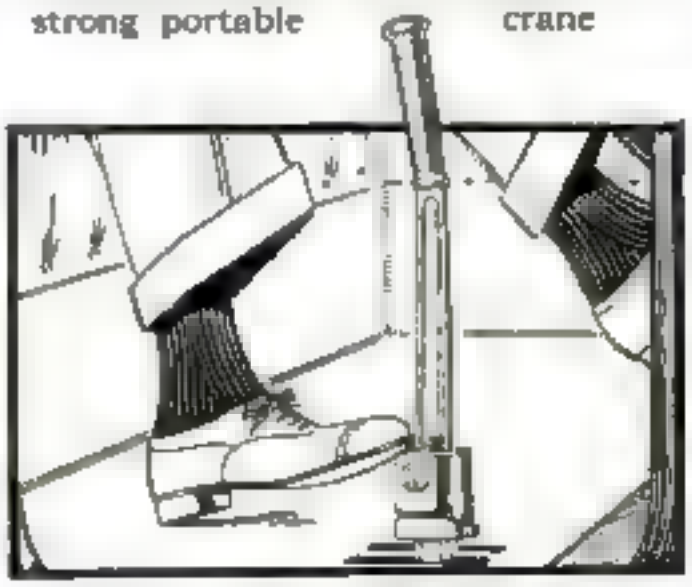
An attachment by which a Ford is converted into a six to twelve horse power stationary engine

A spark-plug cleaner which makes it unnecessary to take the plug apart to scrape off the carbon

Lifting a 1000-pound wheel to the hub of a motor-truck with a strong portable crane



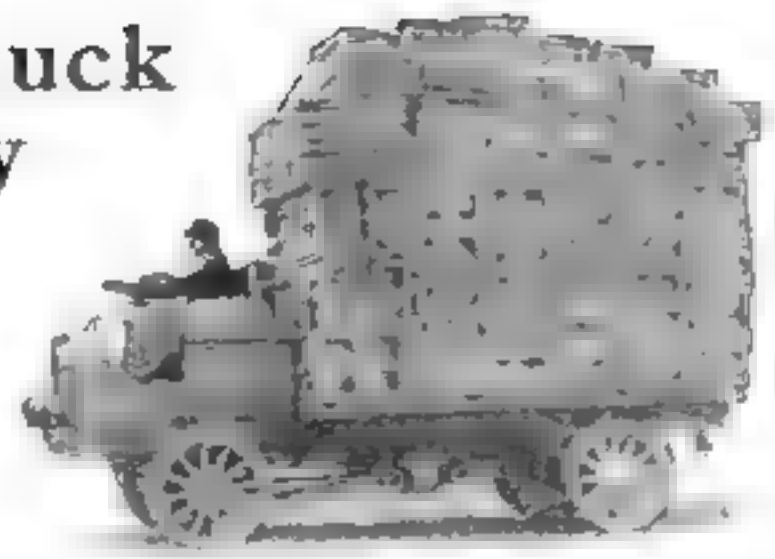
A small transformer, wired as shown, gives steady burning electric lights on a Ford car



Pressed down with the foot a slot-block locks the gearshift lever, thus foiling thieves

Measuring Motor-Truck Loads Automatically

A dial registers the readings from all four wheels as the load is distributed



Overloading is one of the greatest dangers which the motor-truck owner fears. It is a question of correct weight distribution

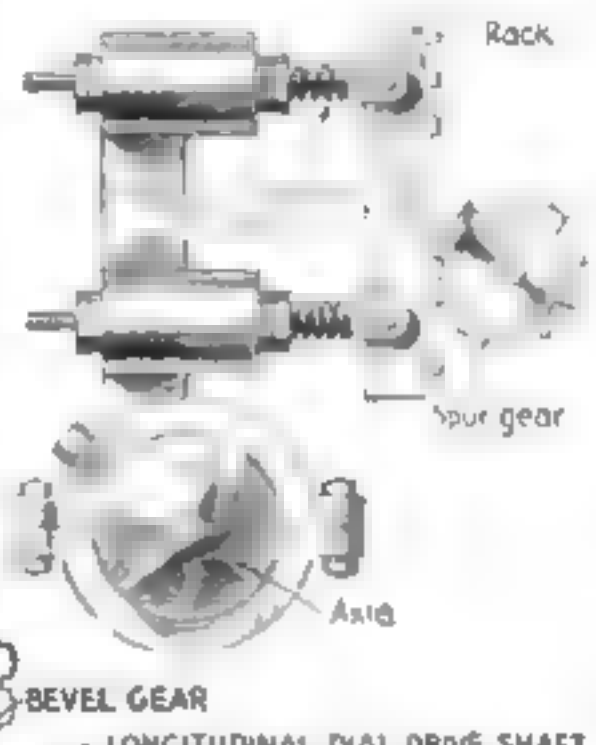
OVERLOADING of motor trucks would be entirely eliminated if all such trucks were fitted with the novel load-measuring device shown in the accompanying illustrations. The apparatus makes use of the relative motion between the axles and springs of a vehicle as loads are applied. The varying deflection of springs for loads of different weights is allowed for by calibrating the dial scale on which the loads are read.

The device differs from most others of its kind in that the weight carried on each wheel is recorded on the dial as the load is distributed, and not only that on the rear wheels. The proportions of weight over the truck body must be the same as when the device was calibrated or else the reading will not be a true one. This makes it possible for the load to be properly distributed over each wheel.

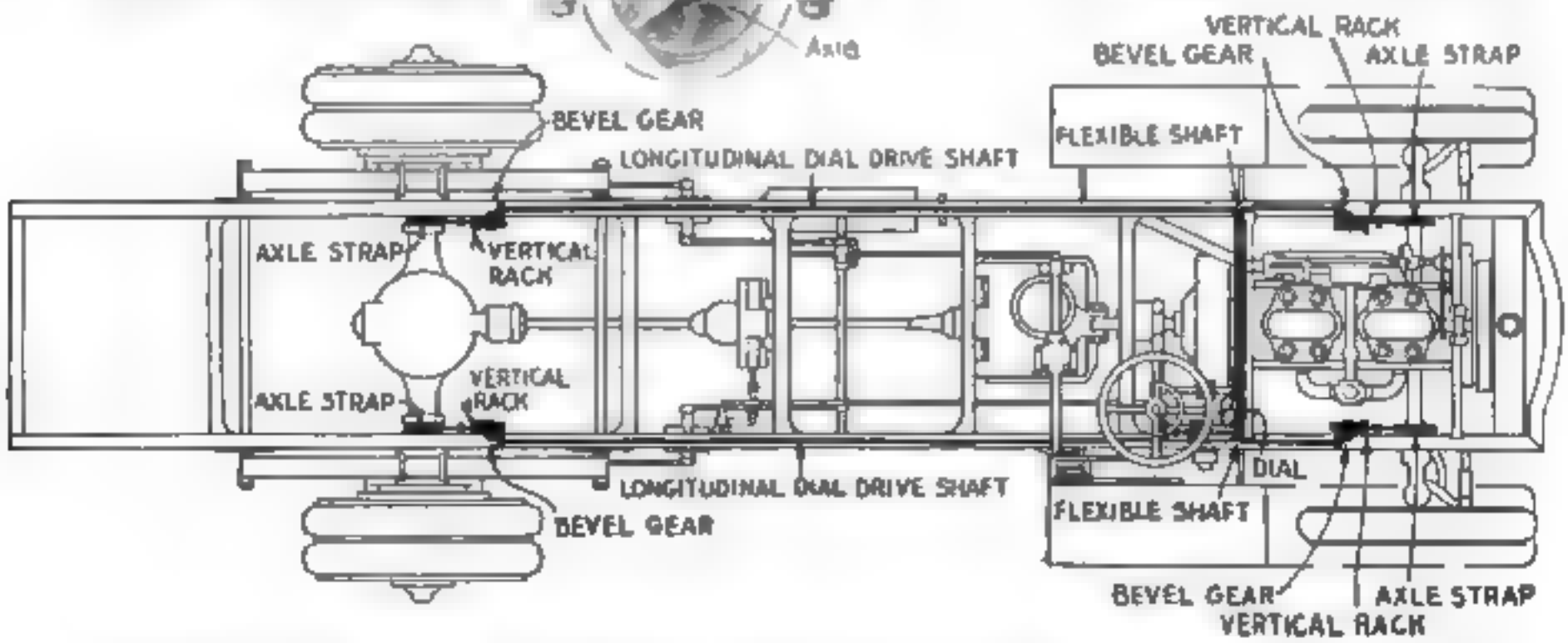
The readings are obtained through the use of four vertical racks, each carried rigidly on a strap round each axle near the ends, the rack revolving a spur gear mounted on the frame and driving a longitudinal shaft inside the frame channel through a bevel-gear unit. The revolution of the shaft is transmitted to the reading dial placed on the dashboard of the truck in sight of the driver by means of a flexible shaft.

As the load is put on the truck, that portion supported by each wheel forces the spring carrying that wheel down and causes the spur gear on the frame to revolve about the rack nearest that spring, simultaneously turning the corresponding longitudinal shaft and the flexible shaft registering the relative motion between the spring and the axle on the reading dial. The weights carried on the other three wheels are registered in a similar manner.

The registering dial is a clever piece of mechanism which consists of a cylindrical casing with a central fixed stud carrying loosely four gears of like diameter



Detail of the rack which revolves the spur-gear mounted on the frame

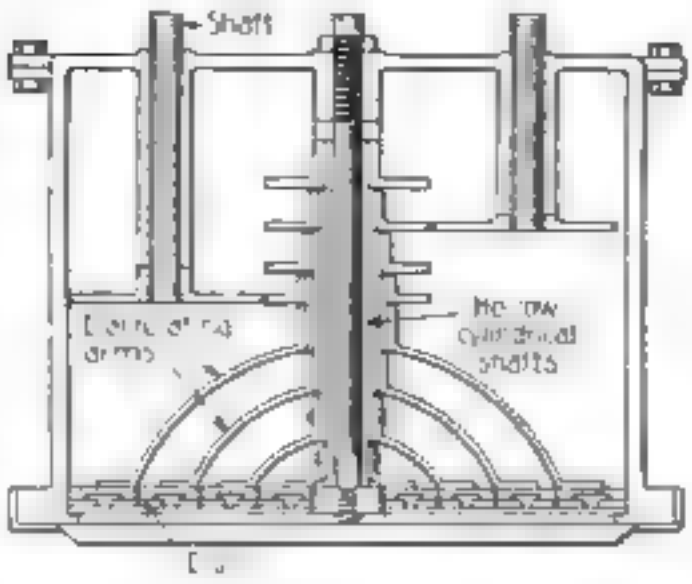


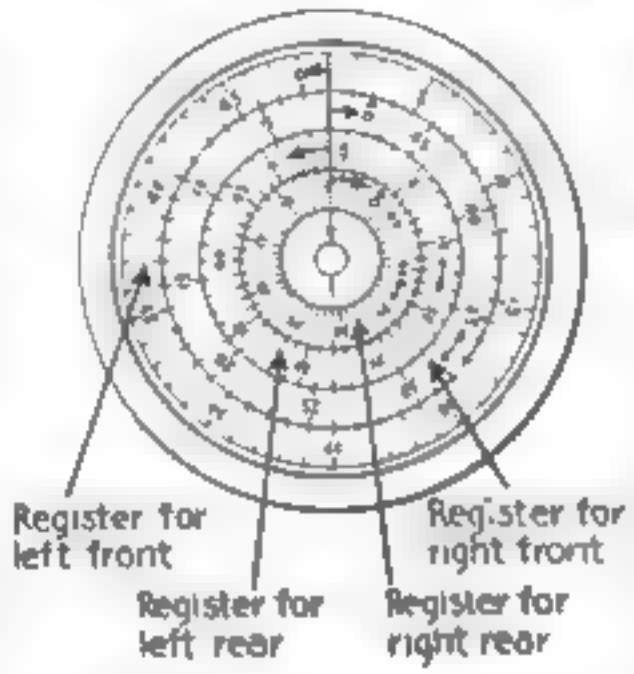
The readings are obtained through four vertical racks, each carried rigidly on a strap round each axle near the ends and each revolving a spur gear driving a shaft through a bevel-gear unit

spaced along its length on telescoping journals. Each journal carries a hub to which are attached curved radial arms or spiders of similar contour but of varying sizes. At their outer ends each set of spiders carries a concentric ring in the same plane and these together constitute the face of the registering dial.

These rings are moved to the left or right of an assumed zero load line drawn from the center stud to the circumference of the casing by means of spur gears on the end of each flexible shaft which extends through the back of the casing. The spur gears are within the casing and are arranged as planets around the central stud and in mesh with the corresponding gears carried on it. This gearing is so arranged that the movement of the rings clockwise in reference to the zero line refers to the loads carried on the two right wheels of the truck, looking toward the front, and the counter clockwise turning of the alternate rings refers to the loads on the left wheels. Calibrations on each ring enable the load on the corresponding wheel to be read directly in multiples of 100 pounds or fractions of tons as desired.

With the dial mechanism remaining the same, the movement of the registering rings may be accomplished in two other ways in one of which a piston attached to the vehicle frame works in a cylinder substituted in place of the vertical rack on the axle to force a fluid to a second cylinder having a piston whose rod carries a rack turning the end of the flexible shaft leading to the measuring dial. The latter cylinder may be provided with a small fluid well with a screw-in piston by means of which the compression of the fluid may be varied for calibration purposes.





The load carried on each wheel is given on the dial. Above: How the revolution of the shaft is transmitted

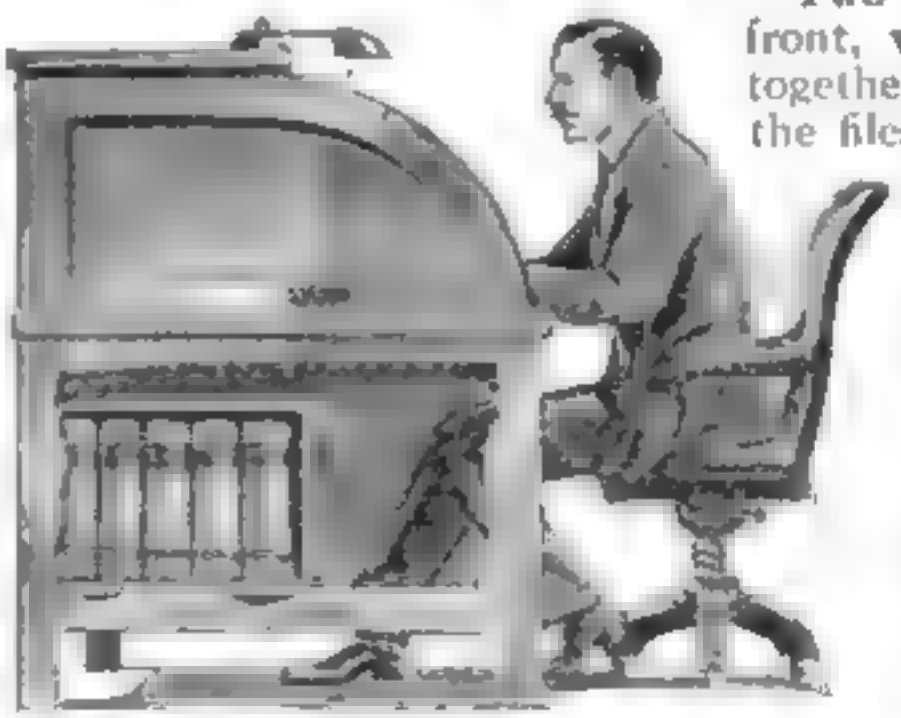
Still another method employs a steel tape attached to the top of the axle near each wheel and carried over a roller on the vehicle frame and thence to a take-up wheel with a spring coiled around its axle and its outer end made fast to the frame.

Not Even the Space Under This Desk Is Wasted

HENRY J. WILLIAMS, of Brookline, Massachusetts, has patented a filing rack which utilizes the space under the desk beyond the reach of the knees. The rack slides forward when the letters are being filed; then a push by the hand sends it back out of the way. The desk is thus as comfortable as before, while expensive floor space otherwise wasted is made use of

The rack consists of a platform which is supported upon waxed strips for guides. The platform can always be reached by the foot and drawn forward when wanted. A light chain on the platform is attached to the rear of the desk so that the rack cannot be pushed too far forward and the letter files be spilled.

Two bars are provided in front, which when brought together and locked, prevent the files from being removed.



A sliding letter rack utilizes the waste space under the desk. This is locked into place

The most popular office desk of the present day is the flat-top style. Under it there is an unusual amount of space which could easily be utilized to advantage by the installation of such a cabinet or rack as the one described The material or books are kept free from dust.

Our Big Guns and How They Are Made

It is the most powerful thing on earth, is a great gun, but its actual firing life is not as long as the life of a butterfly

Illustrations by Kadel and Herbert

IT is not easy to understand what the power of a gun really is—its penetrating and destructive power. What we call a 15-inch gun—which means one whose muzzle or hollow part is 15 inches in diameter—will hurl a shell right through a plate or wall of the hardest steel 12 inches thick seven miles from the muzzle. The power of the very largest land guns ever made—the German howitzers or 16 5-inch guns—is such that one of their missiles cracks open a steel and concrete fort as if it were a nut.

"Built-up" and Wire-wound Guns and What They Are

There are two classes of guns—naval guns and army or land guns. Because they can be manipulated more easily than those of a ship, land guns are the heavier. From eight to ten miles is the greatest distance that a gunner can cover successfully at sea. The largest naval gun is the 15-inch English gun on the famous superdreadnought, and the largest land gun is the German howitzer. Of the two the naval gun fires a shell weighing over half a ton, while the other fires a projectile a ton in weight. But the new giant 16-inch guns of the United States defending the Panama Canal and New York at Sandy Hook shoot projectiles weighing 2,370 pounds, which is over a ton. These immense steel guns can sink a ship before it has really come into sight on the horizon, the location of the battleship having been determined by airplane or tower.

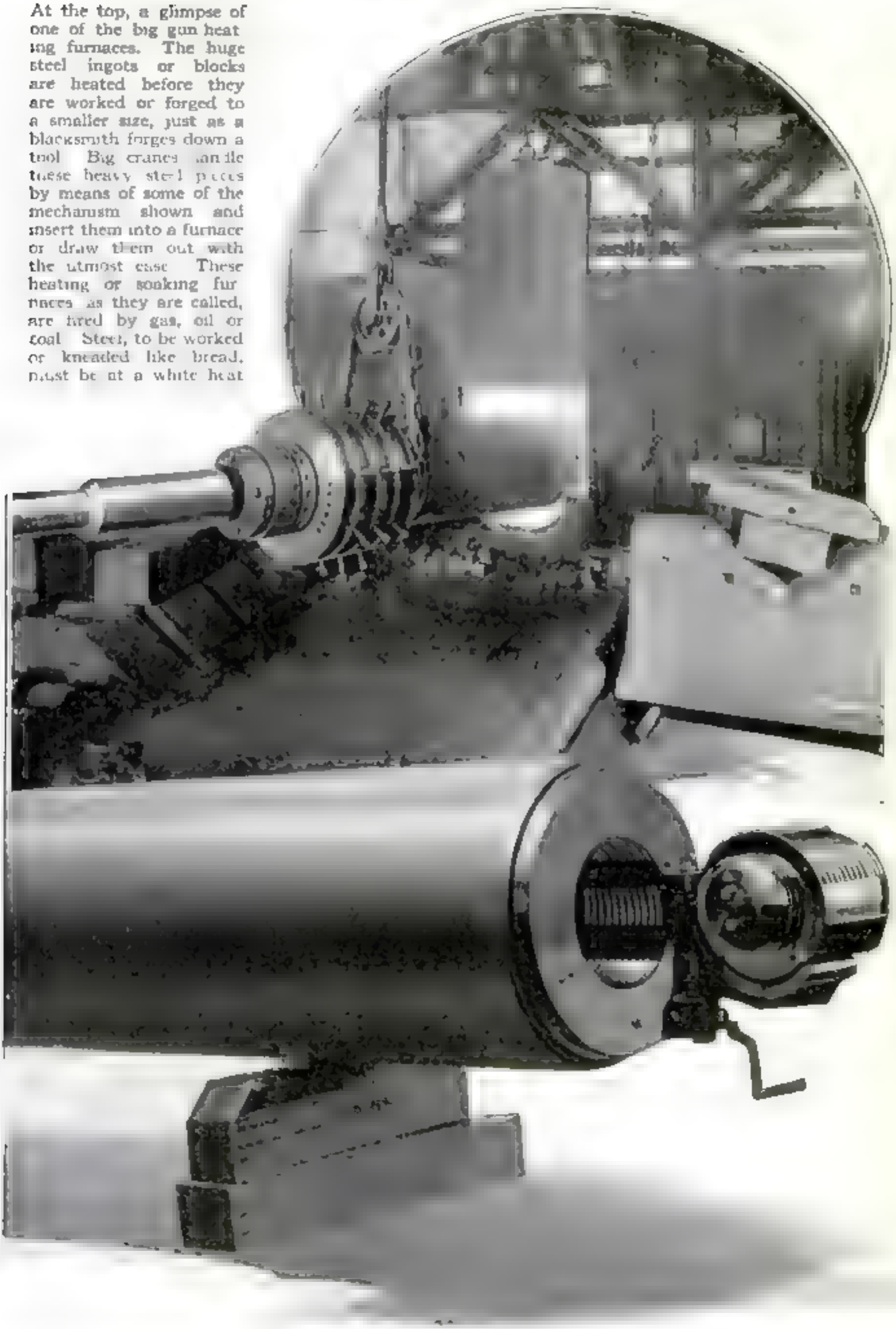
How are these huge pieces made? The first step is the making of the pig iron from iron ore in large furnaces like towers, called blast furnaces. Then the pig iron is melted with other steel in large steel furnaces called "open hearth," until it is freed of its impurities and converted into steel

The melted steel, thin as water, is run from these furnaces into big iron molds where it is allowed to cool into large solid cylindrical or corrugated blocks. After cooling these are reheated and reduced in size by pounding them with big steam hammers and squeezing them in rolls until at last the steel is pressed into a long barrel-like mass, the embryo of a real gun. This long skeleton of the inside of a gun must be bored out from one end to the other on immense lathes, some over

The man is leaning against his completed work—an immense steel gun—the most powerful product of his skill. The various hoops that go to make up such a weapon are easily picked out—large steel bands which are put on one after another as described in the article. It is impossible to determine whether this is a built-up or wire-wound gun. The breech is clearly shown

Stages in the Making of a Big Gun

At the top, a glimpse of one of the big gun heating furnaces. The huge steel ingots or blocks are heated before they are worked or forged to a smaller size, just as a blacksmith forges down a tool. Big cranes handle these heavy steel pieces by means of some of the mechanism shown and insert them into a furnace or draw them out with the utmost ease. These heating or soaking furnaces as they are called, are fired by gas, oil or coal. Steel, to be worked or kneaded like bread, must be at a white heat



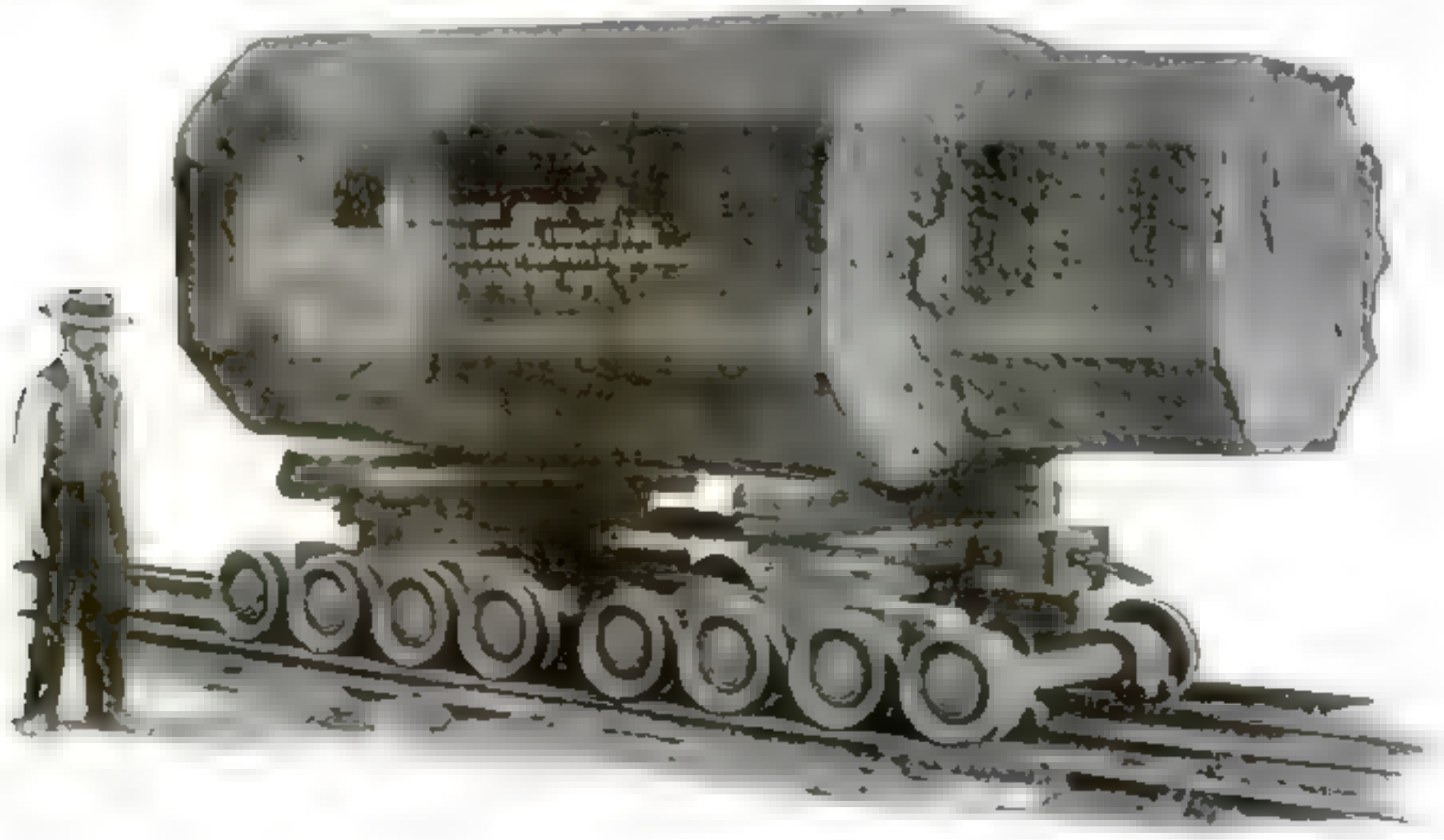
90 feet long. Heavy as the mass is, a huge lathe turns it around as easily as a body turns a spool.

After the inside has been rifled or scored to form an inside surface that gives the shell a twist before it leaves the muzzle and causes it to fly straight, the lower or muzzle end of the gun is made larger. This may be accomplished in one of two ways. Either additional shorter steel tubes are placed over the main inner tube, or the main tube is wound with wire and finished with an outer tube. The wire-wound guns are usually the heavier and are used on board ship.

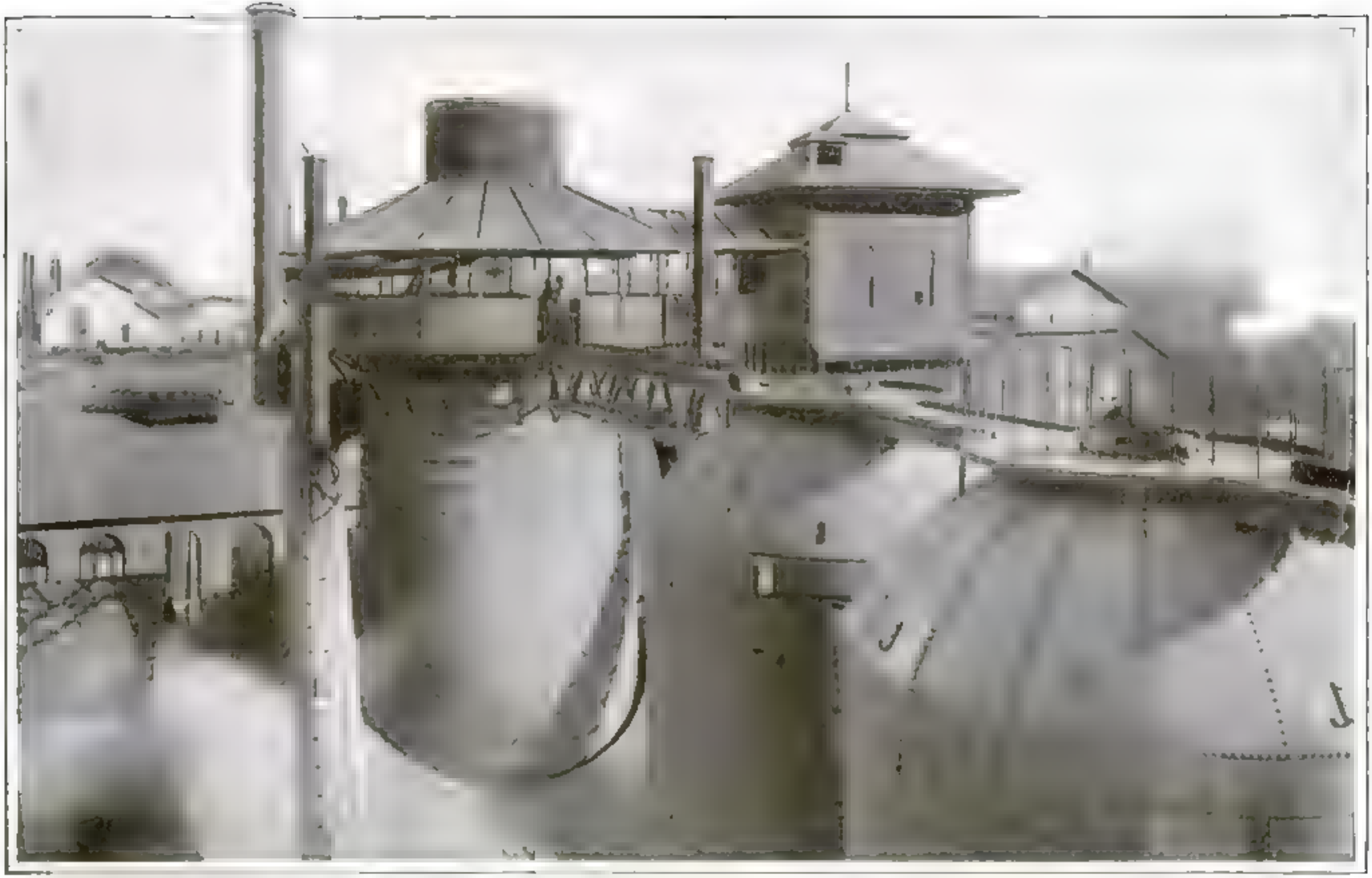
Why the Wire-Wound Gun Is So Strong

The gun bound with wire is really stronger than the one built of bands or rings of steel, one on another; for the wire reinforces the gun tube so that it will safely withstand the tremendous strain which is constantly put on it when it is fired—said to be as much as seventeen tons pressure on each square inch. This means a pressure on every little space inside the gun as big as a domino of over 38,000 pounds. No wonder that a gun

The upper portion of a blast furnace in which pig iron is made—the first step in making steel. These men are dumping iron ore, coke and limestone into the large hopper. The materials are allowed to fall at intervals into the inside of the furnace where the intense blasts of hot air cause them to melt, mix and fuse together until they are tapped out at the bottom



This is a steel ingot. It is the large block of steel resulting from pouring the hot liquid steel into a large mold and allowing it to cool. After it is cold the ingot is taken, in the manner here shown, to the large forge shop for conversion into a big gun. This block weighs something over 111 tons



Another view of the top of a blast furnace where the same [illegible] are charging or filling it with iron ore. These furnaces are high and resemble stacks In fact they are more like giant chimneys, the gases ascending and the ore and fuels descending. Part of each furnace or stack is visible. The two dome-like objects, nearly as high as the blast furnace, are two of the three stoves always necessary for running such a furnace. These stoves heat the blast to a high temperature which is the principal factor in converting the ore into iron in the blast furnace itself

A Great Modern Gun-Shop Where the Giant

The immense machine shop of one of the largest American steel companies making big naval and army guns. The sides of this vast building are lined with machine after machine and lathe after lathe for cutting off and reducing to accurate size sections of steel for various purposes. Extremely accurate and skilled work is done here by experienced mechanics.

Tubes of Guns Are Machined by Lathes

In the near foreground of the picture above can be seen the barrel of a big gun that is being bored or cut out hollow on its inside by a big lathe. Some of these lathes are very long. In the section of the picture on page 42 one of the guns in a crude shape is being carried by a big electric traveling crane to a large lathe where the first paring or cutting is to be done

The red hot steel about to be plunged into the oil tank for what is known as its "heat treatment." The tank extends down into the ground. The plunging of the hot steel into the oil suddenly cools it and hardens it and refines its grain or texture. After this it must be heated up again to temper it

must be strong and that its life is short!

In the case of a "built-up" gun, as it is called when made of hoops or bands of steel, the outer tubes or rings are shrunk or sweated on—that is, they are heated so that they expand or swell a little, as all steel does when heated, and then while hot they are fitted over the inner part and allowed to cool and shrink, or contract. In so doing they fit very tightly on to the main tube. In making a wire-wound gun, the wire is wound or coiled around and around until more than one hundred miles of it has been wrapped around the big cannon. A 12-inch gun requires 117 miles of wire weighing about thirteen and one-half tons. Although the strength of the wire is such that it gives great resisting force to pressures exerted sideways, it does not bestow strength lengthwise. Therefore an extra thickness of metal must be put on the muzzle of the gun where the vibration caused by the shell leaving the gun is the greatest.

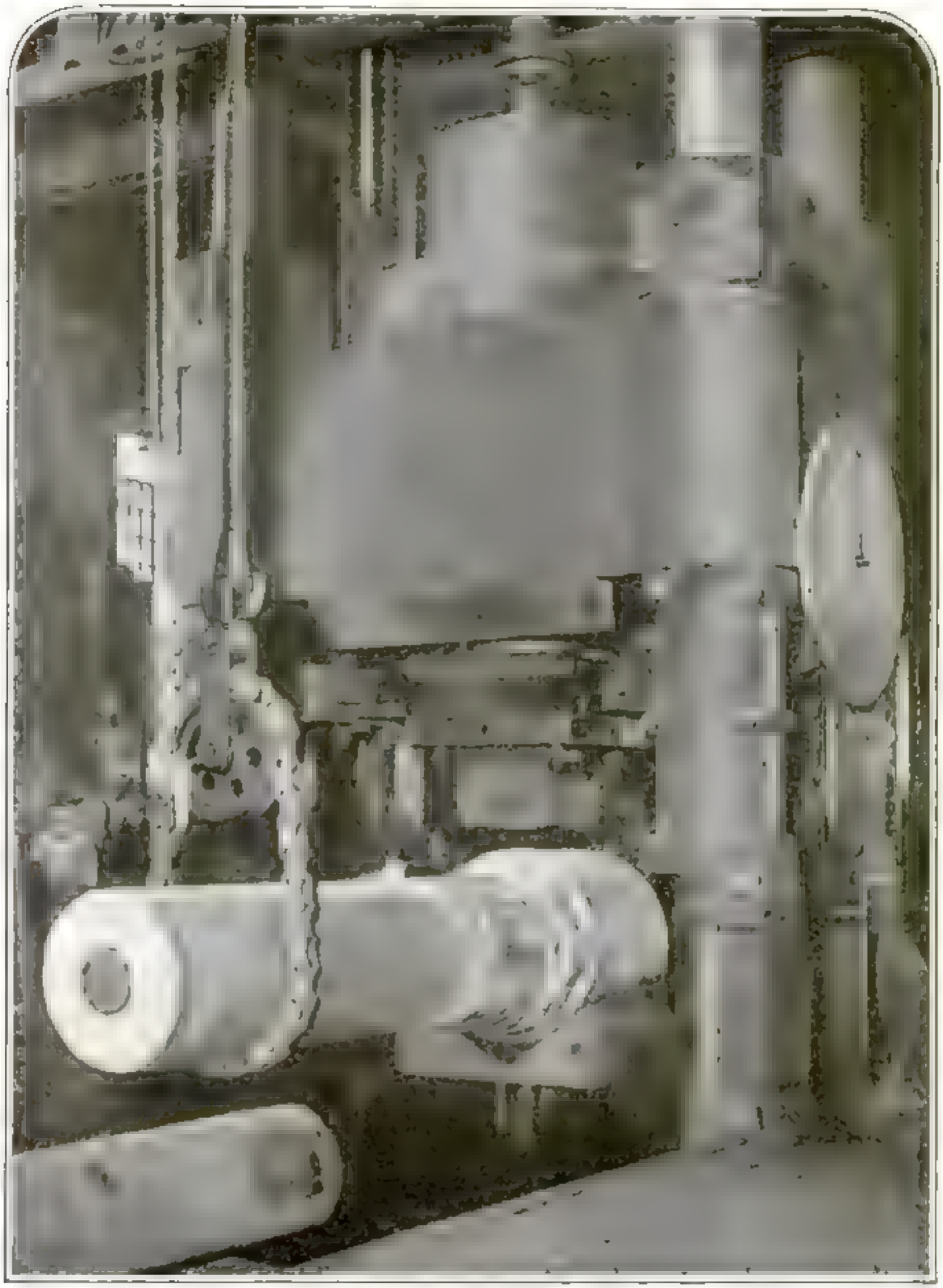
The breech or back end of a gun is a very important part. Here the shell is inserted in a specially built chamber. After the shell is in place, the breech is closed by the shutting of a very complicated and strong door. It is fastened or fitted in the gun by extremely strong screws so that the charge will not burst the gun open at the back when it is fired.

Sometimes a shell explodes in the barrel of the gun. In a wire-wound gun the wire tends to prevent a grave disaster; it hinders the steel tubes from bursting into many pieces and flying in every direction. The solid gun is wholly built of tubes, while in the wire-wound gun there may be one or two tubes over which the wire is wound with the jacket tubes shrunk over the wire. A bush for the breech-ring is screwed into the rear end, which is also reinforced by a breech-ring outside.

Heat Treatment and What It Means

With all these precautions to make a big gun strong enough to withstand pressure, the result would not be successful except for the extreme care in making the steel and its "heat treatment." Steel in its crude state, or when originally cooled from its molten or liquid condition, is one mass of crystals relatively large and intimately knit together. But when these crystals are large the steel is not as strong as when they are small and fine. The object of heat treatment is to render all

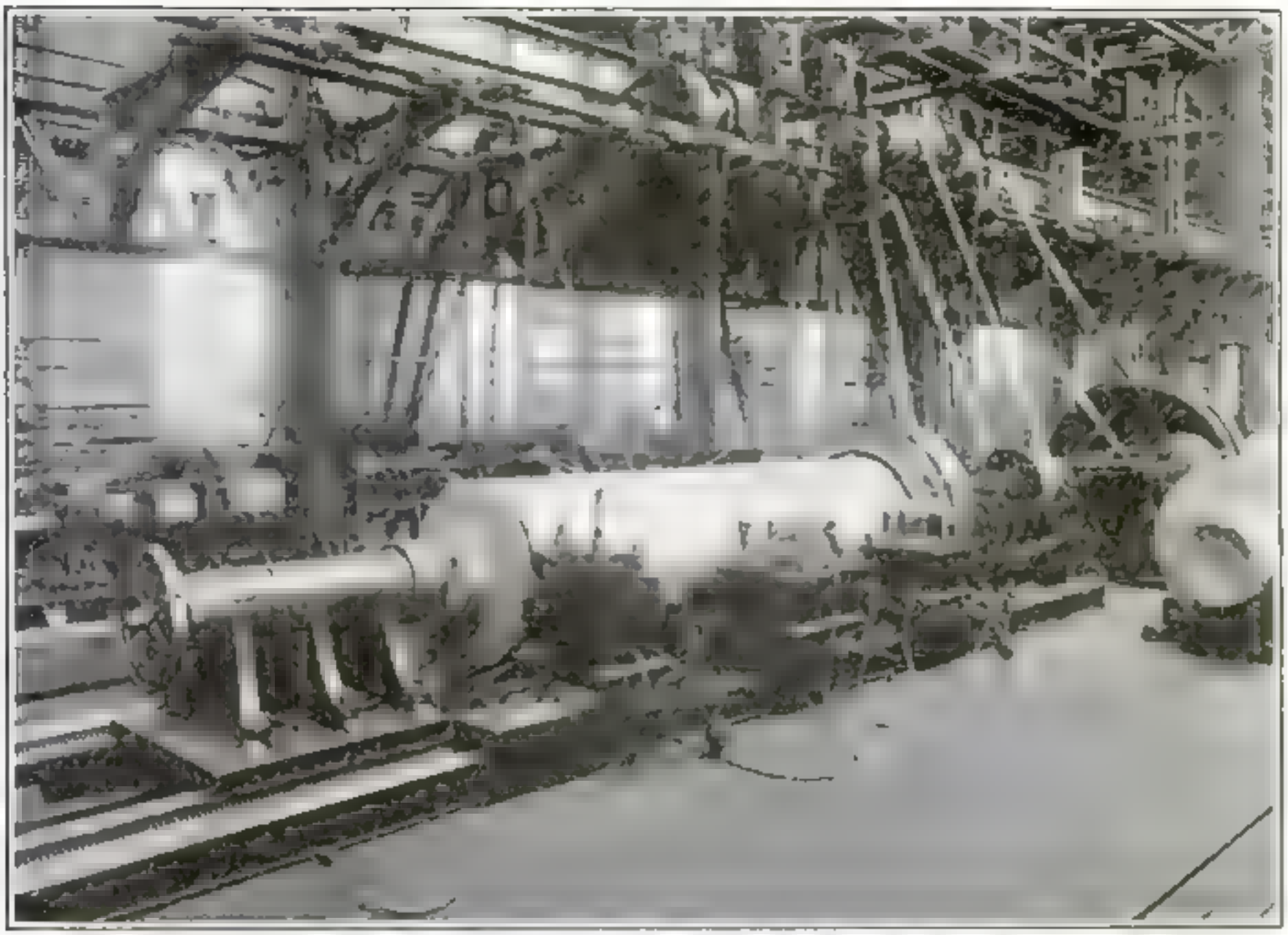
Forging a Great Gun



One of the tremendously powerful "mechanical blacksmiths" or hydraulic presses which work down to smaller sizes the white hot large steel blocks or ingots. Gradually they are thus converted into long cylindrical pieces, the embryo or starting point of the gun itself. These immense presses are worked by levers which cause the ram in the center to obey the will of the operator. Cranes and mechanical apparatus, as shown, can turn this red hot block over and over at will

Cooling the Steel Under Pressure

Steel, when it cools, contracts to such an extent that a hollow space is always left in the center of the upper part of a large body of metal. The extent of this cavity, or "pipe," is greatly reduced under pressure so that this natural contraction is taken up or prevented and a solid block obtained. The picture represents what is known as a fluid compression plant or press in which hot steel can be allowed to cool under a constantly increased pressure



Making the first cuttings from a large round forged steel block which is to become part of a big gun. The work is being done on a large lathe in the machine shop plant. Another steel ingot or block can be seen just at the edge of the picture Powerful cutting tools are necessary

the crystals fine or to "refine the grain" as it is called. To do this the steel gun in one stage of its manufacture is heated until red hot throughout. In this condition it is suddenly cooled by lifting it high in the air and lowering it with a big electric crane down into a big tank of oil. It is thus suddenly cooled and the crystals made very small.

But the gun in this condition is so hard that it has to be tempered or annealed. This is done by heating up the steel again to a lower temperature and cooling it slowly. This operation greatly toughens and strengthens the steel.

There is something wonderful and also mysterious about the flight of very heavy shells and the energy that makes them go. It is,. of course, the charge of powder in the back end of the gun that does the work. An electric spark explodes the charge, which is usually a nitro-glycerine compound. If gunpowder increased in the requisite quantity, the gun itself might burst before the shell was driven out; modern smokeless powder burns more gradually. You can light a cigar with it, so slowly does it burn. The principle of the phenomenon is that the explosive is, when ignited, at once changed to a gas which, confined in a tiny steel chamber, must find its way out. As it does, the shell is forced out by the only opening left.

The life of a big gun is surprisingly short. The powerful explosive, such as cordite for example, creates an intense heat on the walls of the cannon. This gradually melts at each shot a little of the inner surface, constantly wearing away a thin layer of the steel. It is sometimes called the erosion of a gun. This erosion, or wearing away, is so persistent and gradual that the very big guns can be fired only a limited number of times. It is said the actual life—that is the sum total of the time consumed in the firing of the shots as long as a gun lasts—is really in some cases not more than a second or two. After that a new steel lining is put in.

Many things have been tried to reduce erosion, for the cost of one large gun runs into many thousands of dollars.

Two thin coatings of plaster of Paris are washed lightly over snugly fitting jerseys

The cast comes off in sections and is then filled in on the inside with paper mâché

wash of plaster of Paris is applied to the outside. When this is partially dried another coating is applied. After this second coating has dried a little, the tapes connecting the two portions of the jersey are untied, and the two parts, front and back, are taken off separately and allowed to dry thoroughly. The shape is then filled in on the inside with *papier mâché*. It requires only about an hour to make the form, which is less than is often required by the modiste for one fitting of a fashionable expensive garment.

Casts of the arms may also be made and attached to the form, so that the figure is complete. The mold may be used on any lay-figure standard or it may be set on a table or stand of convenient height. The only objection to it is that it is not adjustable. If the stout woman makes up her mind to reduce and accomplishes her purpose she will have to order a new dress-mold in consequence. Similarly, the too-slender woman should not use her dress-mold after she has been through a building-up course of treatment, until she has had its lines altered.

Making a Second "Self" for Dressmaking Purposes

FITTING is the hardest and most tedious part of dressmaking. Many a woman could make her own clothes and save a good percentage of her pin-money if she were sure that the garments would have the proper "set." There are various kinds of dress forms on the market to meet this need. One of them, recently invented by Wayne T. Sachs, of Los Angeles, Cal., is cast on the lines of the living figure to be fitted.

To make it, two jerseys are fitted snugly over the body. The outer one is made in two sections connected by strips of tape. After the jerseys are adjusted, a thin

The Youngest Manufacturer of Automobiles

ALTHOUGH only twelve years old, Clarence Suttcliffe, of Aurora, Ill., has constructed a real automobile which makes record time for its size. His materials were obtained mostly from scrap heaps. His one purchase was a one-quarter-horsepower gasoline engine.

The machine is belt-driven and will make a speed of fourteen miles an hour. In the absence of a clutch, the young manufacturer shuts off the engine by means of a foot-lever. When rounding corners he presses down on the lever; this shuts off the spark. The car is called "G-3."

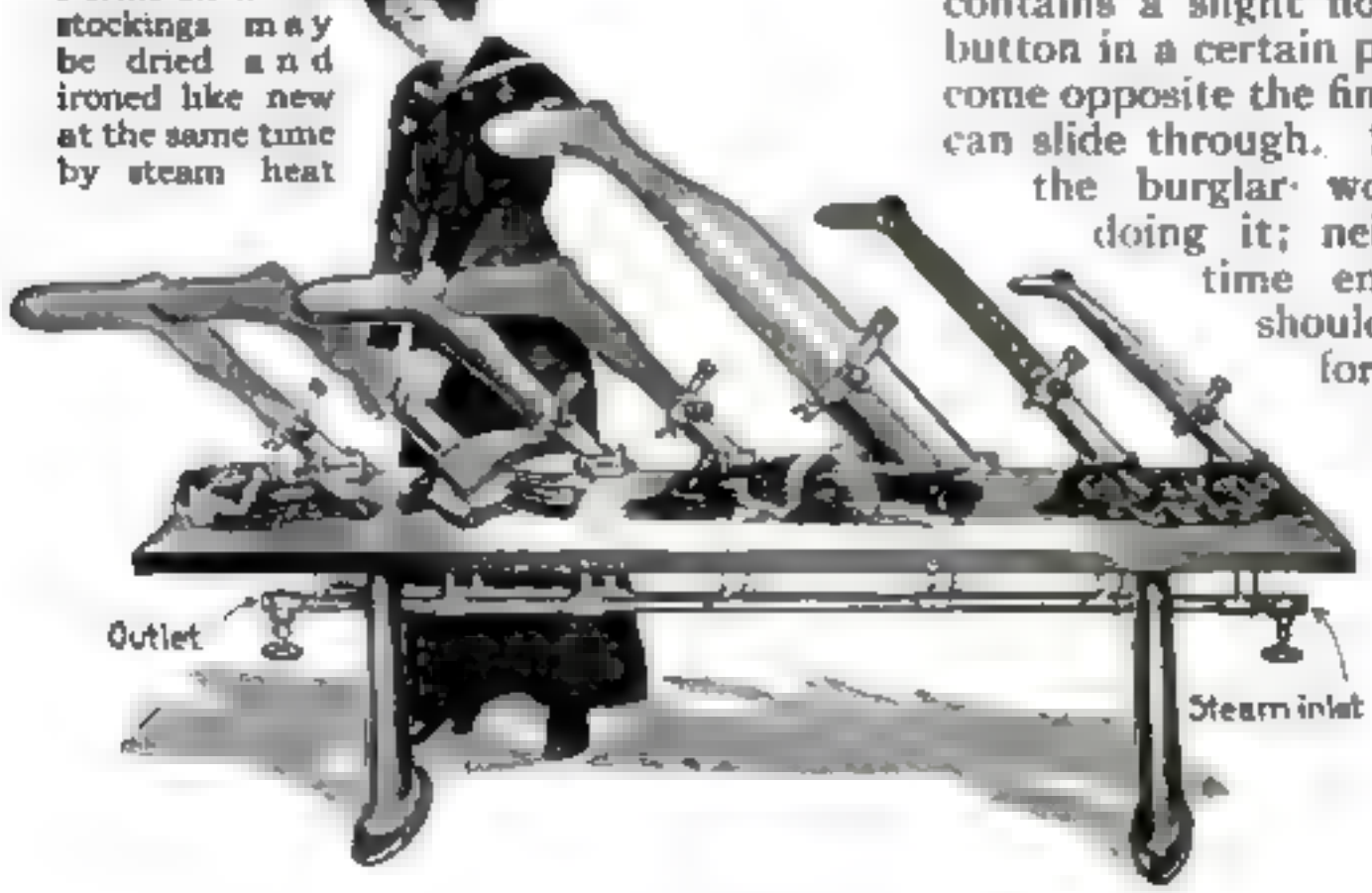
The little automobile is a single-passenger model, but it is capable of accommodating a trailer

The Laundry Keeps Pace with the Fashions. It Irons Stockings

THIS is the day of conspicuous and elaborate hosiery. The laundering of stockings and socks has had to keep up with the fashion. Formerly it was necessary only to smooth out the wrinkles, regardless of any "shine" that might be imparted by the iron. In home laundries the queen of the washtubs often considered it unnecessary to iron the hosiery at all.

Now, however, a fine stocking can be laundered in such a way that it will look exactly as it did when new. A stocking ironer has been invented which employs forms over which the wet stockings are drawn after they have been washed and rinsed. The steam heat is turned on and the stockings are dried and ironed at the same time from the heat inside the forms. In this way the original shape and luster of the stocking is retained and any embroidered design is brought out in relief.

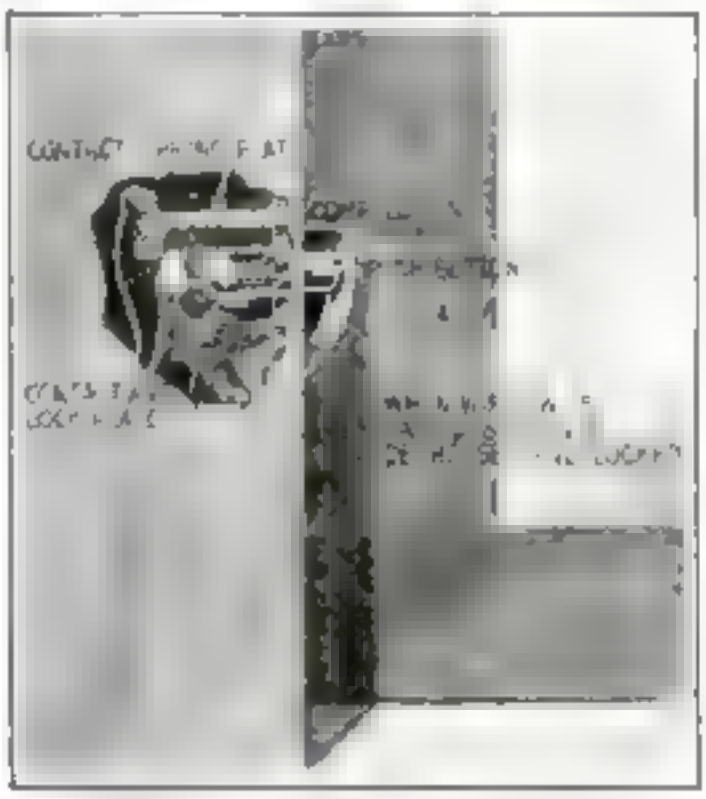
The ironer is intended principally for use in large laundries having steam power, although it can be adapted for the home laundry. The forms are of all shapes and sizes. They prevent shrinking of all-wool stockings, also.



Forms on which stockings may be dried and ironed like new at the same time by steam heat

An Alarming Alarm for the Burglar. He Could Never Turn It Off

AN entirely new burglar alarm which prevents a burglar from opening your window stealthily at night has been patented by William Connoly, of New York. Once the window is started upward, the noise of the alarm will upset the nerves of the burglar himself.



Raising the window pushes in the button, closing the alarm circuit

The alarm is extremely simple. An automatically locking push-button fits into the window frame just above the lower window. A flat-head bolt is screwed in back of this push-button and makes contact with the iron mounting in which it slides. The bolt and the button are normally pushed in their outermost position by a spring inside the mounting.

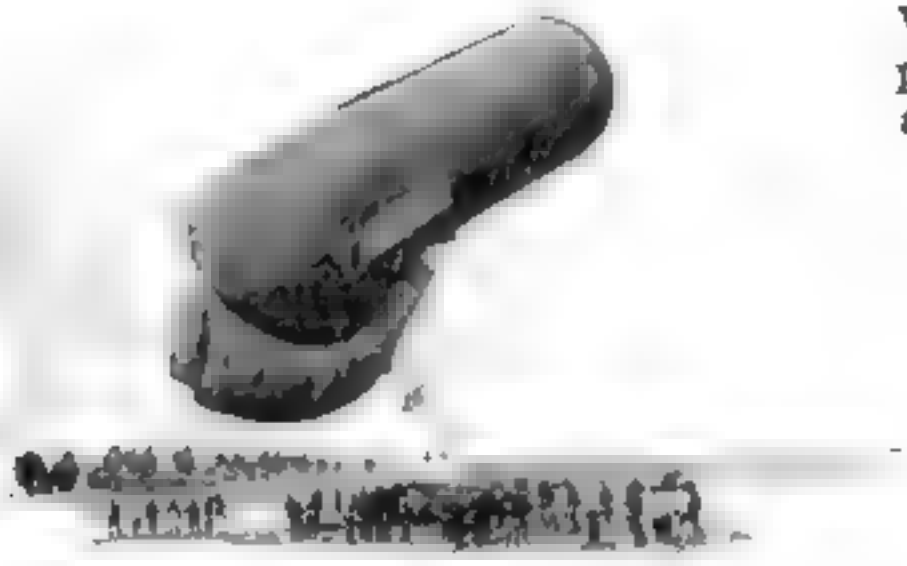
Should Mr. Burglar jimmy the window, the button is pushed in as the window is being raised. Immediately the head of the bolt passes a contact finger. The bell circuit is thus closed through the bolt and the finger. Thereupon the righteously indignant landlord reaches for his gun. The iron finger prevents the button from being brought back. So if the burglar supposes he can turn off the alarm before anyone inside hears it, he will be horribly disillusioned.

Only a person familiar with this alarm can turn it off. The flat head of the bolt contains a slight notch. By turning the button in a certain position, the notch will come opposite the finger, and the bolt-head can slide through. Simple though this is, the burglar would never think of doing it; neither would he have time enough to do it if it should flash across his mind; for there is nothing faint-hearted about the alarm. Its evident intention is to arouse not only the members of the household but the policeman on the beat and all the neighbors on the block or in the vicinity.

Fighting the Big Guns from Balloons

Why the observation balloon still plays a part in war despite the airplane and the dirigible

By Carl Dienstbach



The sausage balloon is provided with a wind bag which keeps the balloon nose to the breeze Steadying cones are also fastened to the rope, kite-tail fashion

THERE never was a time in the history of fighting when a general did not envy the birds. If he could only hover over his enemy and see for himself what was going on! Since he could not do that, he used such makeshifts as he could devise. But the first real spying on the enemy came when the balloon was invented

Someone asked Benjamin Franklin what he thought of it. "It is a newly born child," he replied. That was non-committal; also prophetic. At all events, the French revolutionists, daring adventurers in war as well as in politics, adopted the balloon at once as a superior substitute for the old watch tower. They held it captive by a rope, quite in the best Twentieth Century way, and used it very effectively in battles to drive home revolutionary truths. Their "aerostiers" even dropped their messages on long streamers of paper weighted with lead.

When the dirigible and the airplane came, it was popularly assumed that the observation balloon was to become as extinct as the dodo. Indeed, in the early days of the present war, observation balloons were never mentioned in the despatches as were the dirigibles and the airplanes. But as the war developed, as weapons changed their character and became even medieval, as all Europe was converted into one huge fortress, as warfare changed into a continuous siege, as guns of unprecedented size and power were brought into action, lo and behold, the old captive balloon came into its own again with a vengeance! It came back with other discarded and ancient weapons—with steel helmets, and with hand grenades thrown from trenches.

Battles of to-day are won by the most terrible of systematic artillery bombardments. The captive balloon, connected as it is with a battery by a telephone wire running through the holding cable, renders it possible to correct the range instantly, and therein lies its advantage over a constantly moving airplane. The balloon is at a disadvantage because of its distance from the enemy—a distance dictated by considerations of safety. But that disadvantage is compensated for by supplementary information gathered by the airplane.

An active enemy rarely permits an observation balloon to stay aloft for even an hour. But as a rule the balloons are so far behind their own lines that they may stay up for a whole day. During the recent engagements around Arras, Sir Douglas Haig reported that he had shot down every German balloon over a front of perhaps twenty-five miles. Such wholesale destruction of observation balloons is posble only under exceptional circumstances. Ordinarily the ranges are too great. But artillery is not the only dread of the balloon. Small, wasp-like airplanes darting in and out with bewildering rapidity, throw firebrands on the thin bladder filled with gas, which explodes even more easily than dynamite. Threatened either by bursting shells, or by these firebrands, the observation officers in the baskets of the balloons, must jump for their lives.

The peculiar sausage-like captive balloons which are now used by all armies, were invented in 1894 by two German army officers. In Germany they are known as "kite balloons." A kite balloon consists of an elongated gas bag with an arrangement by which the wind, caught in internal air compartments by check-valves, distends and stiffens the balloon against itself. A regulation kite bridle is used. The balloon is provided with a fin, consisting of an appended air bag, like a modern kite, and even with a regular wire-tail consisting of a rope having a series of steadying cones.

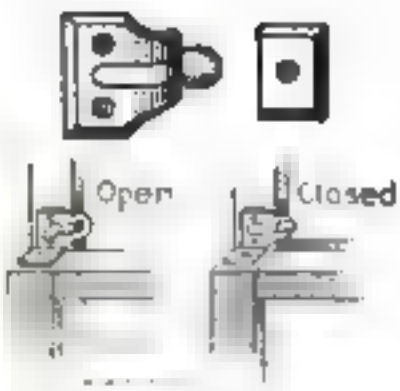
War-Time Uses of the Old-Fashioned Balloon

Photos © Int. Film Serv.

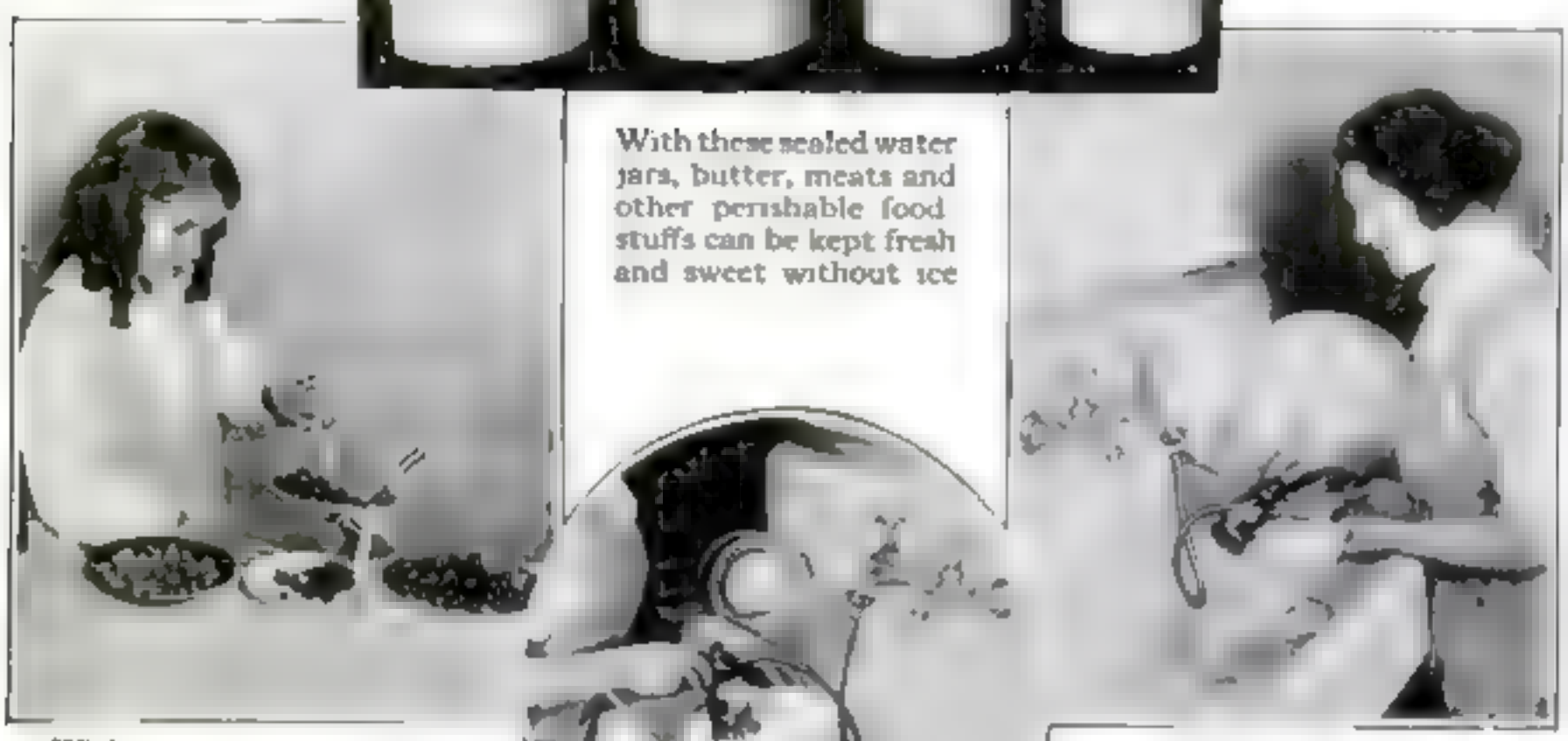
In the oval: An officer in the basket of a sausage balloon. Telephone receivers are strapped to the officer's head. The wires run down through the rope to the ground. By means of the telephone he communicates to the battery the effect of each shot. Upper right hand picture: The man who is sent aloft often in the observation balloon becomes a far more daring parachute artist than any man who ever risked his neck at a county fair. The parachute was intended to serve as a safety device. In the whole history of aerial navigation, it never saved a single life in a cross-country journey. War, alone, justifies its existence. The war parachute is of the ordinary type made familiar by the county fair as seen in the bottom picture. Half an hour after an officer has dropped to the ground to save his life, he is up again in a new balloon

Housekeeping Made Easy

A beater attachment on the ordinary potato masher which adds greatly to its usefulness



A permanent fixture for holding windows open for ventilation and preventing them from being opened further by intruders

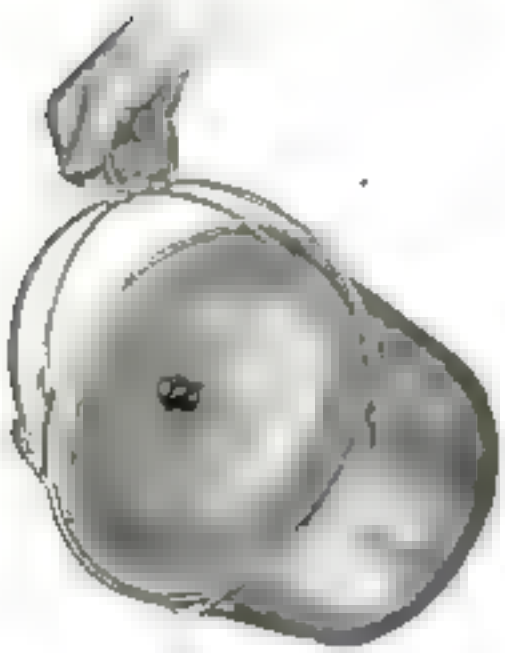


With these sealed water jars, butter, meats and other perishable food stuffs can be kept fresh and sweet without ice

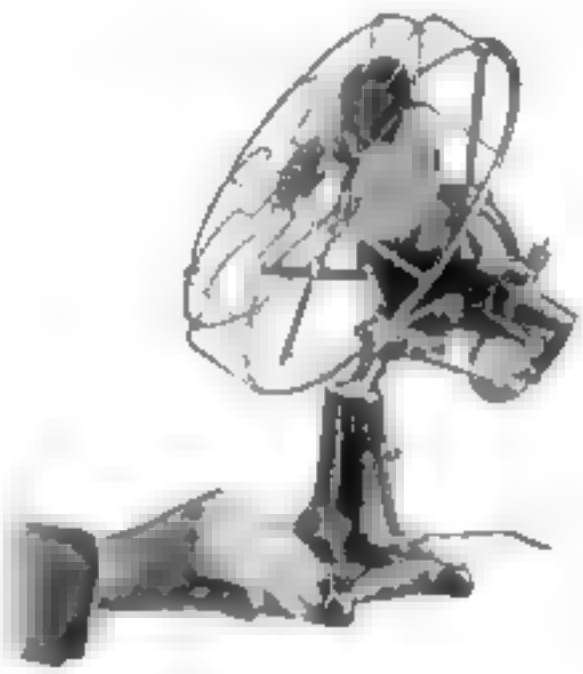
With one revolution of the crank a seed is removed from a cherry without losing any of the juice. The seed is dropped through an opening in the bottom of the tray into a separate dish from that which receives the pulp

Here the brush of the dish washer is in use. There is a soap compartment just above the bristles. The hot water passes down through the soap to the brush and plate surface

A dish washing device which has a small opening like a nozzle through which clear hot water may be thrown on the dishes by means of a th mb operated valve. A brush at one end completes the cleaning process expeditiously

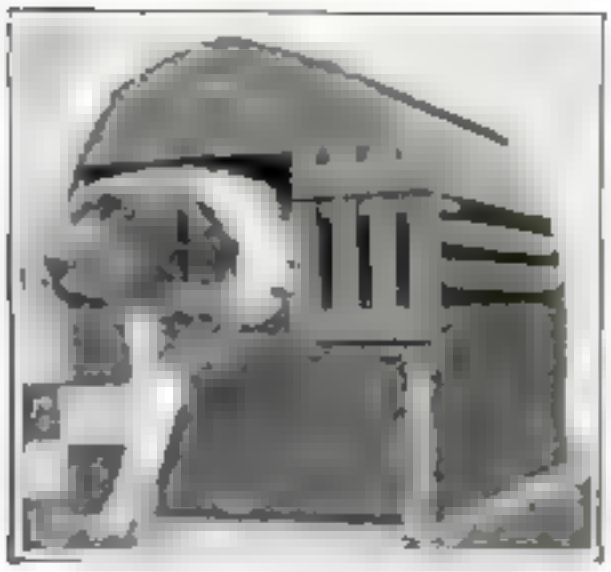


Kettle made in aluminum having a double bail with handle so arranged that it is self-tilting. The contents may be poured out or liquids drained off of vegetables without removing the lid



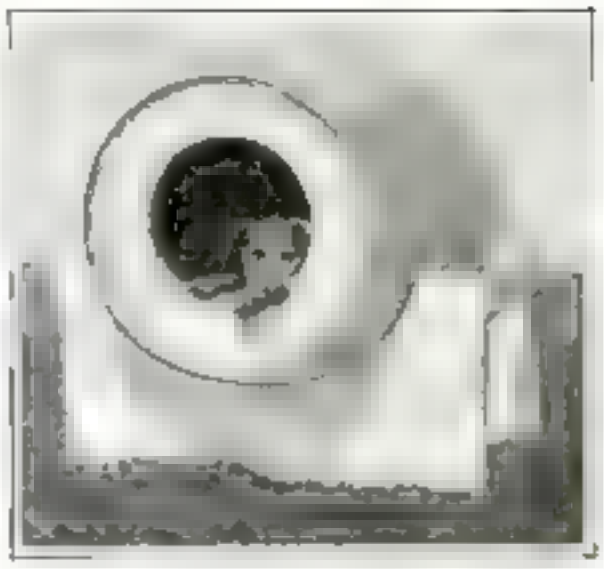
The usual difficulty of directing the breeze from an ordinary electric fan in the larger sizes is easily obviated by the ball joint in the stand. The fan may be set and clamped at any angle

Housekeeping Made Easy



A crate for shipping dogs in safety and comfort without danger to the expressman and porters who must handle it on the journey

Food is put into the dog-crate shown at the left, through a small door in front



A neat appearing and sanitary dog kennel made from a barrel. There is a shaded resting place under the frame support

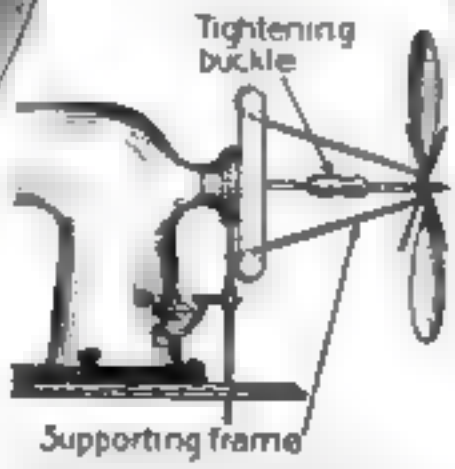
A circular cloth with draw string through six brass rings makes a convenient bag for odds and ends

A shelved wire mesh rack for conveniently keeping the different vegetables separate and where air can circulate through them to prevent decay

A hanging or counter display stand for grocers and fruiterers. It permits free air circulation on all sides

A hat protector made like an envelope. It may be carried in the pocket or handbag as a "preparedness" measure to be used in case of sudden rain

A deodorizer of ornamental design for hanging on a wall of the sick room or to counteract the mustiness of a room that is to be kept closed a long time



A light detachable fan for a sewing machine flywheel

Home-Made Paper Motion Pictures

A safe and sane method by which you can make the pictures and exhibit them to your friends

By Max Fleischer

This motion picture camera is smaller and lighter than the professional machine and requires no tripod. It is aimed from the shoulder through an open finder. The substitution of a motor drive for the hand crank makes it possible to follow the movements of an object. Current is supplied from batteries in the pocket

WHY is the phonograph in every home, but not the motion picture? Chiefly, because celluloid films are highly inflammable, because rooms must be darkened, because screens must be set up, in a word because elaborate preparations must be made. The making of motion pictures is hardly within the possibilities of the average amateur. In professional motion picture photography, extremely accurate mechanisms are employed at almost every step. Perfect results depend on the accuracy, judgment and experience of experts.

The expert camera man is not called upon to develop his film. Developing processes are often as unfamiliar to the photographer as photography is to the developer. Fixing and drying the film is a separate branch of the process. Printing of positive film from the negative requires the attention of skilled mechanics who may be entirely ignorant of camera work or developing.

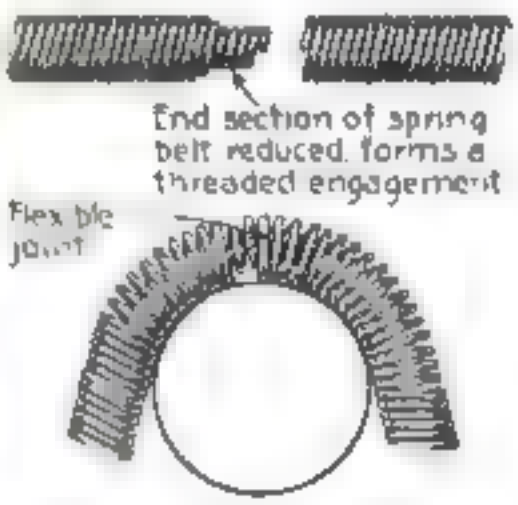
Projection of the completed film is a mystery to almost the entire productive force; for some knowledge of electricity and arc-lighting is necessary. The operator must be alert and cautious. He must be entirely familiar with his machine and its dependent devices. Thousands of feet of highly combustible film must be driven directly across the path of the blazing arc-lamp's concentrated rays. The speed of the film itself is all that keeps it from being instantly consumed. Failure of the drop-shutter, as the film slows down, would result in a blaze. The operator must be specially trained. As a rule, theater projection machines are quite safe—that is, safe in the hands of an experienced operator.

In view of all the knowledge and experience required to go from A to Z in the production and projection of motion pictures, considerable credit is due Mr. Hartwell W. Webb of New York, inventor of the home projector and camera, for his success in simplifying and reducing the cost of the process. In addition to making its operation safe, he has practically succeeded in leveling the complete apparatus to the home basis of the phonograph.

Mr. Webb has produced not only a motion picture camera which is almost as simple in operation as the kodak, but also a projector which requires little more knowledge to operate than the magic lantern. All fire danger has been eliminated by the perfection of a paper film. Incidentally, he has found the paper film to be far more durable and economical than the celluloid.

His camera, which

Interior of the camera. The feed magazine will accommodate 100 feet of film which is advanced by means of a single claw drive

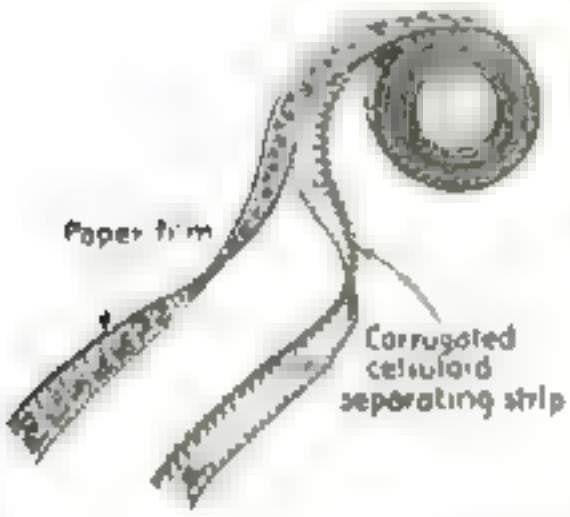


A spring belt, reduced at one end to fit the opposite end of the belt, makes a threaded flexible engagement

weighs about fifteen pounds, is considerably smaller than the professional machine and is operated by a small electric motor. A cell of dry batteries carried in the operator's pocket supplies the necessary current. The

Developing the film in the form of a coil reduces the quantity of solution required. About three quarts of solution will develop 500 feet of film

Below: Method of coiling the film over a wood core for immersion. A frilled celluloid strip is used as a separator between the layers of coiled film



camera can be loaded in daylight. No tripod is necessary.

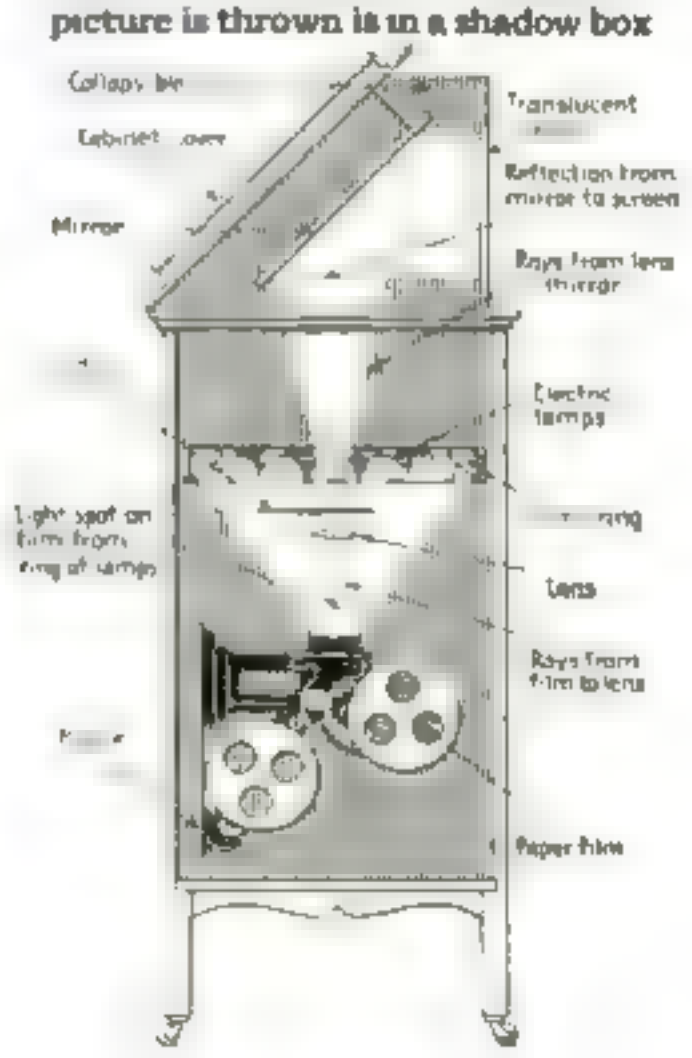
The amateur photographer who has developed his own films will require no additional knowledge for developing the paper motion-picture film. The film is wound around a wood core together with a celluloid strip frilled on the edges The frill acts as a separator between the layers of the film and at the same time allows the developing solution free access to every part of the surface. The film is rinsed, fixed and washed in the usual manner. It is dried on a collapsible wooden drum.

An important feature of Mr. Webb's process is the production of the positive film. The paper negative film is not transparent; therefore a positive film cannot be made by contact. Even if it were possible to do so, it would not prove practical for the amateur, because motion picture film printing by contact is necessarily done by machinery and entails the additional expense of another length of film. A much simpler method has been perfected in which the negative is chemically converted to a positive with remarkable results. One solution removes the silver nitrate from the negative; another bleaches the shaded and dark portions leaving the film blank. On exposure to light, the color values are reversed, the most delicate tones and graduations being retained in the color reversion.

By converting the negative into a positive, it is evident that only one finished positive film can be obtained from each negative. For quantity requirements, a number of experiments have been made with the half tone or engraving process as a printing medium. In this process, the positive film is reproduced on a sensitized copper surface and etched with nitric acid to produce printing plates. In this manner an unlimited number of positive prints could be produced for circulation purposes, paper and ink being the only material required for the work. As the initial outlay for the half tone plates would be large, this method would prove practical only for quantities running into the

At right: The projection principle of the cabinet explained. The reflecting mirror is disposed at an angle of 45° under the lid

At left: The screen on which the picture is thrown is in a shadow box

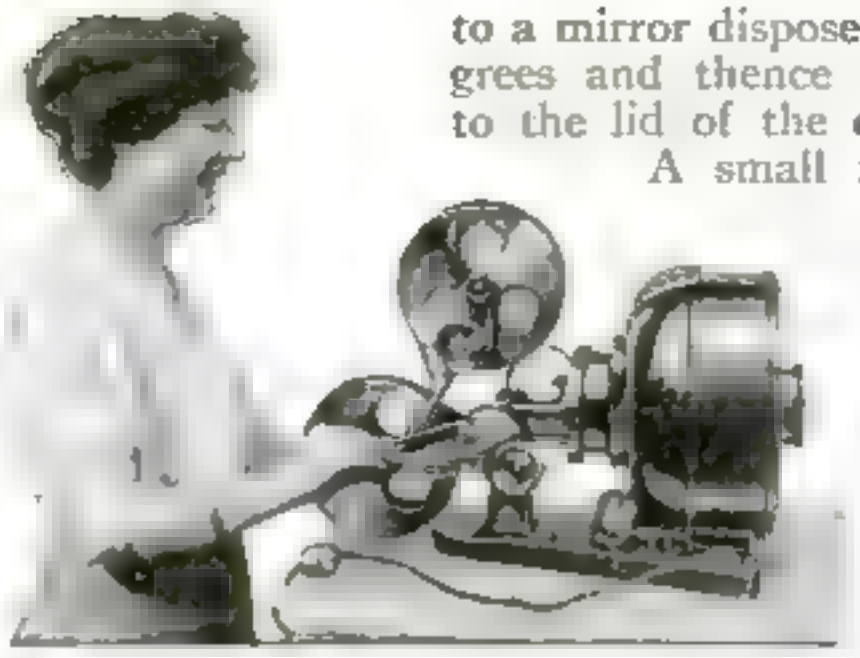


thousands. One hundred feet of film could then be sold for a little more than the cost of the paper, or rented for much less.

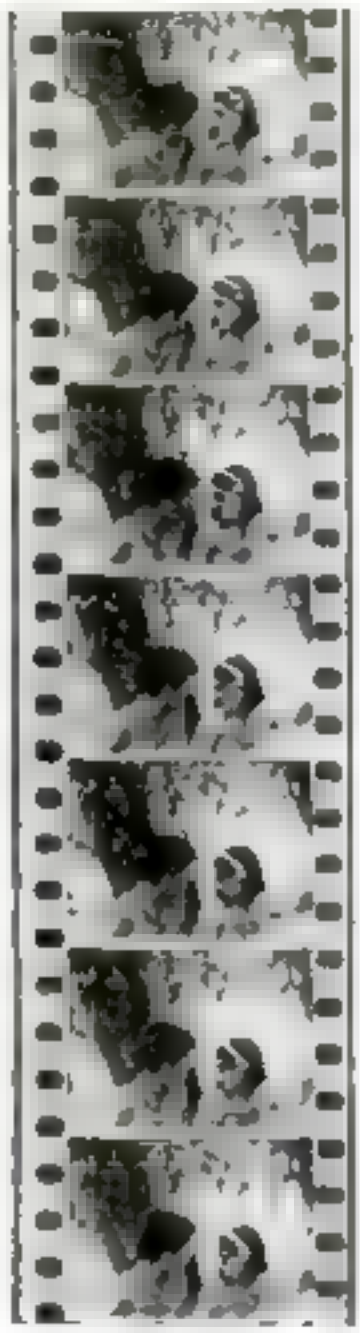
Two types of projectors have been made. One model is intended for use in schools and churches, while the other is suitable for home use. The operating principle of both types is the same; there is a difference only in the range of focus.

The home model is built into a cabinet, resembling that of a phonograph. In fact, phonograph cabinets with slight interior alterations are at present being utilized to assemble the home projector.

Paper film being opaque, it must be reflected, rather than projected on the screen. In carrying out this principle, the projection machine is placed in the lower part of the cabinet with its lens directed upwards towards the lid. Fixed directly over the projector is a brace containing a ring of nitrogen lamps and reflectors which are arranged to throw their concentrated light on a spot over which the paper film passes. Since the nitrogen lamp is very cool, there is no danger of burning the film. The picture is reflected upwards to a mirror disposed at an angle of 45 degrees and thence to the screen attached to the lid of the cabinet.



This form of projector is intended for small assemblages. It may be operated by hand or motor

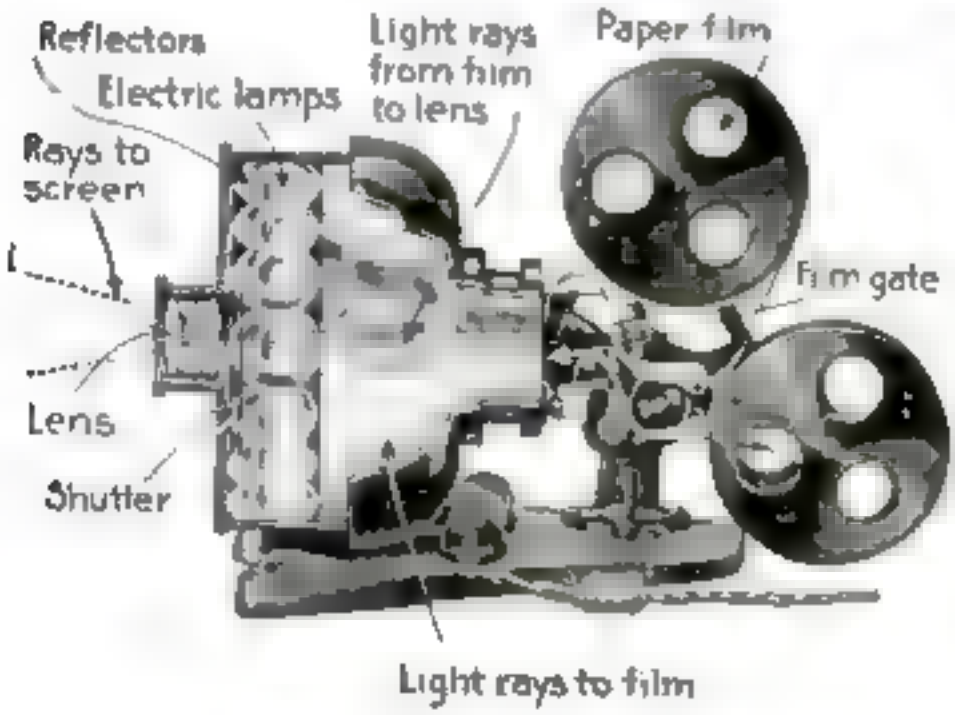


Pictures of absorbing interest can be made of friends and members of one's own family

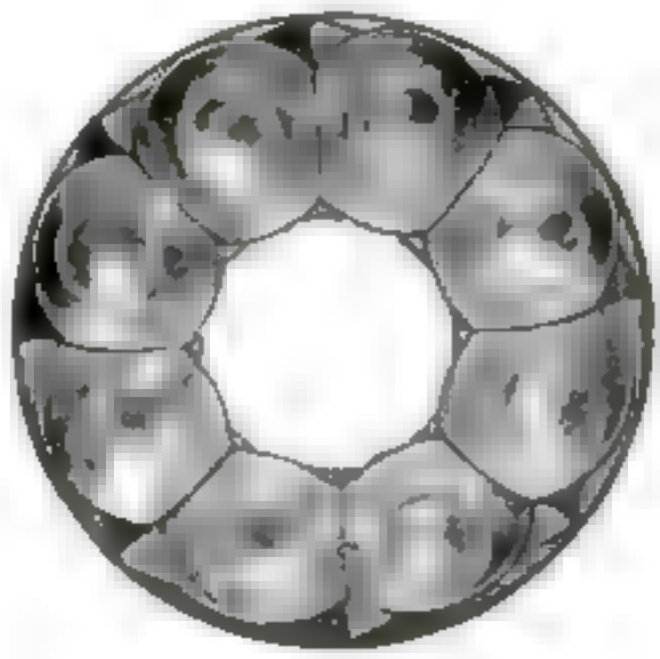
A small motor drives the projector mechanism, electric current being supplied to the motor and the ring of lamps from any convenient lamp socket.

In addition to the animated pictorial record that can be preserved of family and friends and of interesting incidents of sentimental value, Mr. Webb proposes to establish a circulating library which will furnish by mail, at nominal cost, films of current interest occurring the world over. Judging from the popularity of the motion picture theatre, there is every reason to believe that the home picture cabinet will prove as popular as the music cabinet.

It can be made to harmonize with the surrounding furniture, and is as ornamental as the phonograph cabinet, with which it is identical in appearance except for the screen on which the pictures are projected. This screen is collapsible when not in use. It is set in an ornamental frame which serves as a shadow box, so that the pictures may be shown in broad daylight as successfully as they can at night or in a darkened room.



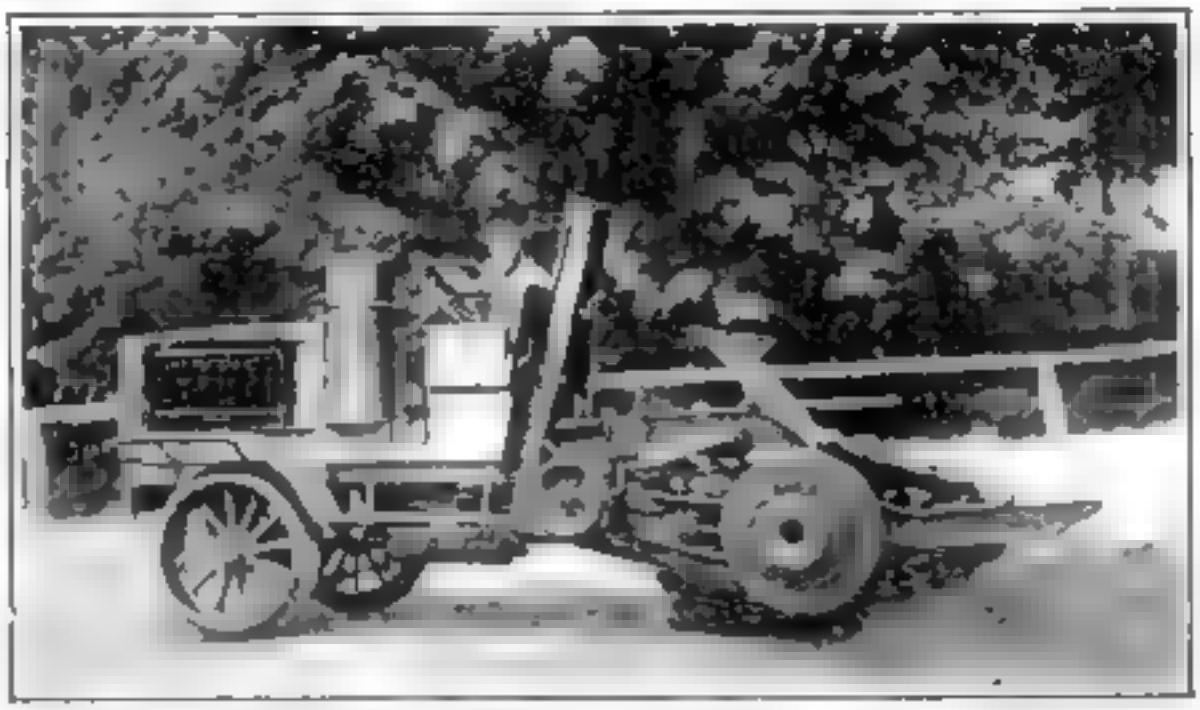
At left: Interior of the protecting mechanism



Circular arrangement of the lamps

A New Type of Caterpillar Motor-Truck. It Can't Stick in the Mud

THE novel commercial vehicle shown in the accompanying illustration differs from other forms of caterpillar tractors in that it has one caterpillar or track-laying unit in the rear and two wheels in front. It is substantially a three-wheeled vehicle with the track-layer as the third wheel. It has a much greater speed than a conventional track-laying tractor. Fifteen miles an hour is within its capabilities.



The track-laying caterpillar motor-truck is a three-wheeled vehicle, with the track-layer as the third wheel

It is especially intended for hauling trailers over rough country roads, but it can run over improved state highways by reason of the rubber tires on its front wheels.

The front wheels are of steel with wide steel tires. The rubber tires are fitted in the center of the steel tire

When running over good roads the front wheels are supported on the rubber tires, but when soft roads are encountered they sink into the ground. The wide steel tires then support the tractor and prevent it from being mired.

If any of the trailers should stuck in the mud, a rope around the winch on the track-laying unit is employed to extricate them. Although this truck is equipped with the caterpillar unit it would not be possible for it to negotiate shell craters and deep trenches as readily as its predecessor, the British tank. Hence it is not designed for war service.

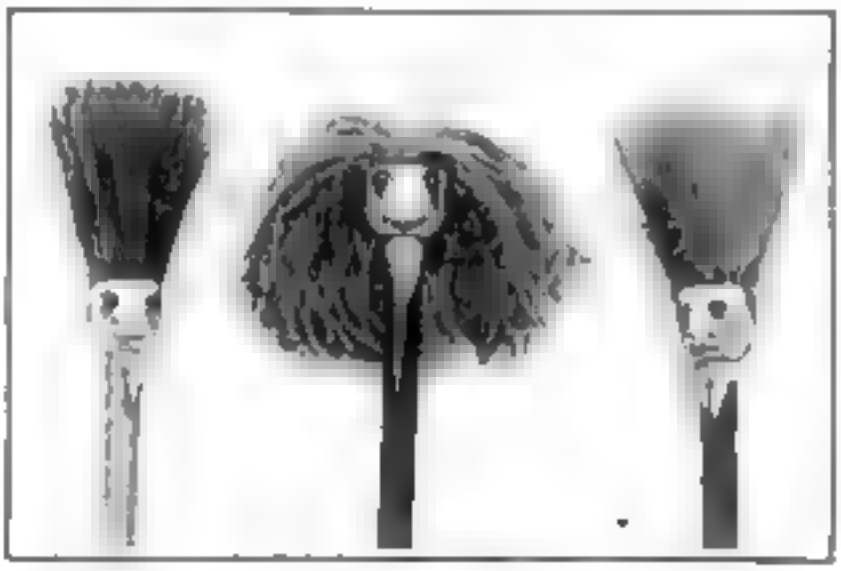
The Convalescent Soldiers Are Ingenious Toy Makers

THE war has indirectly been the cause of driving many erstwhile clerks and mechanics but now soldiers into the ranks of the toy makers. The invalid soldier finds not only employment for his enforced idle hours but a certain amount of recreation as well in devising original toys.

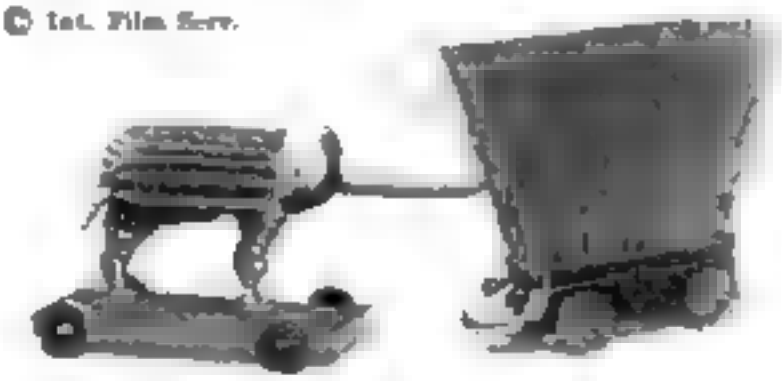
In order to make a really successful toy, one must needs have a more or less intimate knowledge of child-nature. The men who made the designs shown in the accompanying photographs must have had in mind a picture of some toddler leaving all the expensive toys that Santa Claus had left around the Christmas tree and going persistently back to mother's old dust-brush or broom.

The articles pictured, the work of maimed or blind soldiers, were exhibited at the Lyons Fair. Black and white paint and large shoe-buttons for eyes converted the long-handled brushes and brooms into individualities, while clever carving in conjunction with paint and shoe-buttons and wooden wheels made stands for other types of brushes, which immediately became fierce and wonderful animals with accommodating holes in their noses for strings.

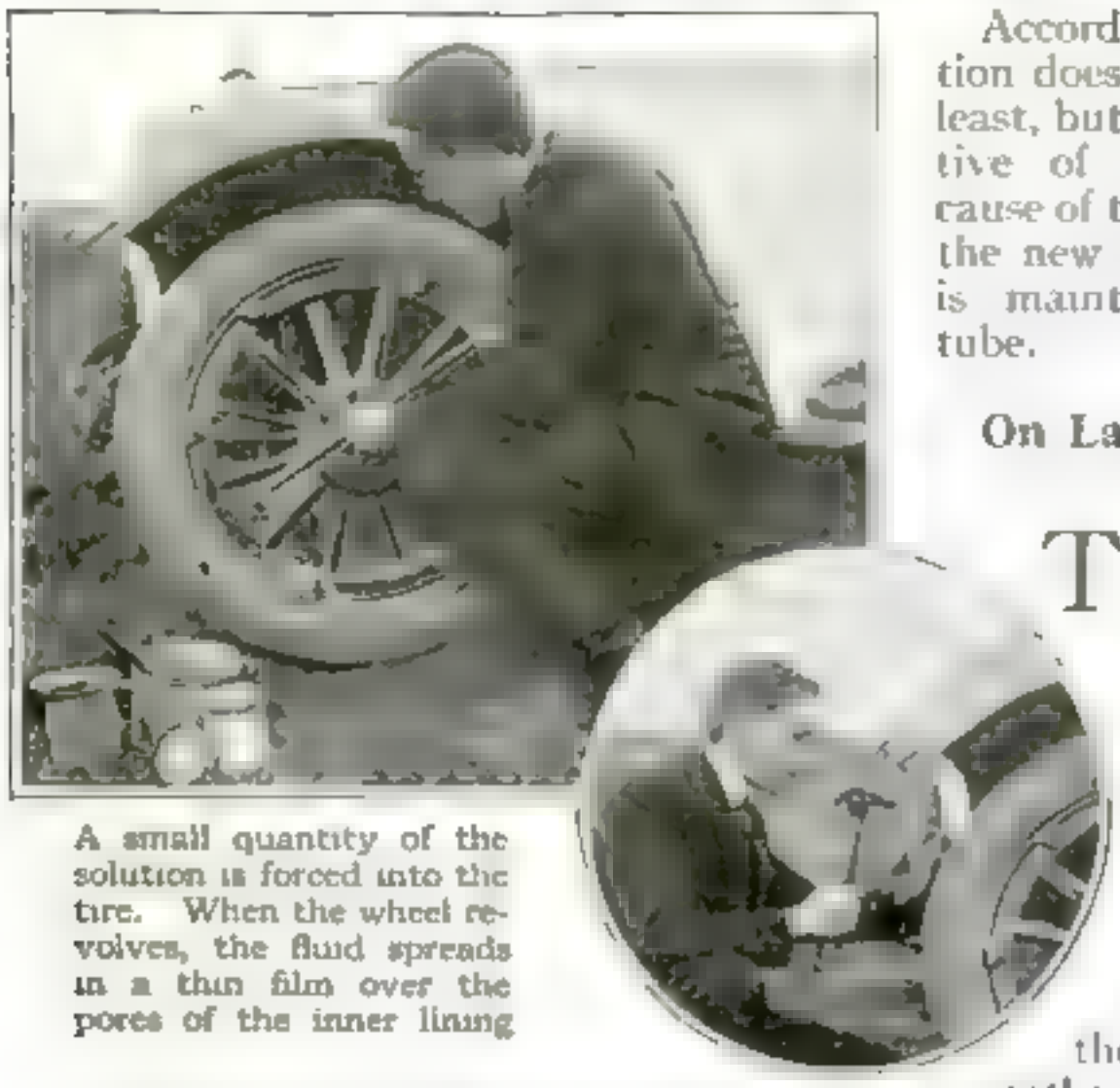
But the toys do not lose their utilitarian quality permanently. When they are no longer needed as playthings they may be returned to their hooks in the kitchen.



© Int. Film Serv.



The long handled brushes and brooms were converted into individualities by black and white paint and shoe buttons for eyes. They required some clever carving too



A small quantity of the solution is forced into the tire. When the wheel revolves, the fluid spreads in a thin film over the pores of the inner lining

A Solution Which Promises to Solve Some Tire Troubles

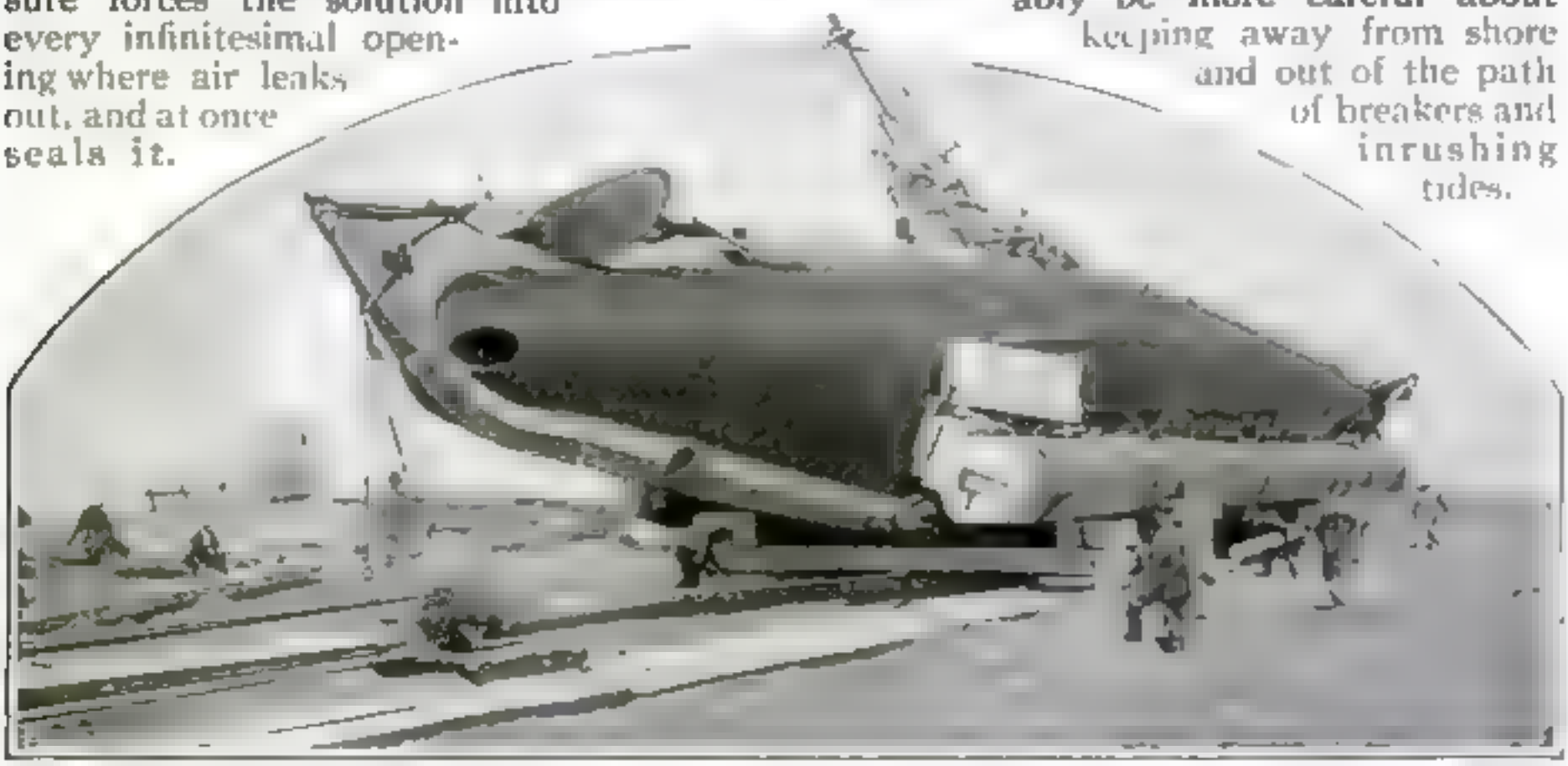
A SOLUTION which is injected into the inner tube of an automobile tire through the stem is said to keep the tire at normal inflation and to make it practically puncture proof. The solution lies in a fluid state at the bottom of the tire, occupying only six per cent of inner space, except when the car is in motion, when centrifugal force carries it around the tire in a thin film, thereby sealing all porous places that cause slow leaks. The fifty or eighty-pound pressure forces the solution into every infinitesimal opening where air leaks out, and at once seals it.

According to chemists' reports the solution does not injure the inner tube in the least, but is, on the other hand, a preservative of rubber. Under-inflation is the cause of the majority of tire troubles. With the new solution the proper air pressure is maintained at all times in the inner tube.

On Land a Submarine Travels at Tortoise Speed

TO her great surprise, the U. S. Submarine H-3, of the Pacific division, woke up one day to find herself high and dry on the sands of Samoa Beach, California. It was not exactly the proper place for a perfectly respectable submarine, and plans were immediately devised to launch her. The best launching place was Humbolt Bay, nearly a mile distant, where the land goes down rather abruptly from the shore. So the submarine was jacked up and laid upon a wire cradle formed between two huge logs. The cradle and its burden, wheeled upon small logs as rollers, were then moved slowly forward by hauling on a block and tackle. This is the first authentic report of a bona-fide submarine taking an overland journey.

As a land animal, however, the submarine is not very spry—she makes about one hundred and fifty feet in an hour. Under water she travels at from six to eight miles an hour. Hereafter she will probably be more careful about keeping away from shore and out of the path of breakers and inrushing tides.



When the U. S. Submarine H-3 became beached, she had to be jacked up on a massive log cradle and pulled on four sets of huge rollers to a suitable launching place nearly a mile distant

Typewriting in Code on a Specially Constructed Machine

THE war has brought forth many devices for communication in code; and many different codes are used in the different departments, as well as among individuals. The invention of a typewriter which will print in code follows as a natural consequence, for time and speed cannot be sacrificed continually, even in the interest of secrecy and safety.

The code typewriter is a complete typewriter, standard keyboard, with nothing in its appearance to indicate that it is not an ordinary typewriter. On this machine a stenographer may produce the cipher writing with the same speed as though he were writing in English. It is the invention of Edward Hebern, of Oakland, Cal.

All the characters of a standard keyboard may be represented, in the cipher of letters. In placing figures and other characters not letters into cipher the shift key is not operated, but in order to translate them out of the cipher it is necessary to hold down the shift key in copying the cipher letters that represent figures and other characters.

For the receiver of a cipher message to ascertain what letters represent other characters than letters, he simply copies the whole of the message. The parts represented by figures remain in cipher. He then sets the shift key and recopies those portions; the result will be that the figures or other characters will be printed.

An unlimited number of different codes may be used. A change of code is effected without changing the position of the letters on either the keyboard or type. The code is changed by means of a small aluminum device called the "code bar," weighing about one ounce. It is simply withdrawn from a slideway and another bar, set in a different code, is inserted. The code bar contains twenty-six graduated letter blocks. By unscrewing a thumbscrew and moving the letter blocks to a different position a change is made.

The code is changed by means of a small code bar having twenty-six letter blocks

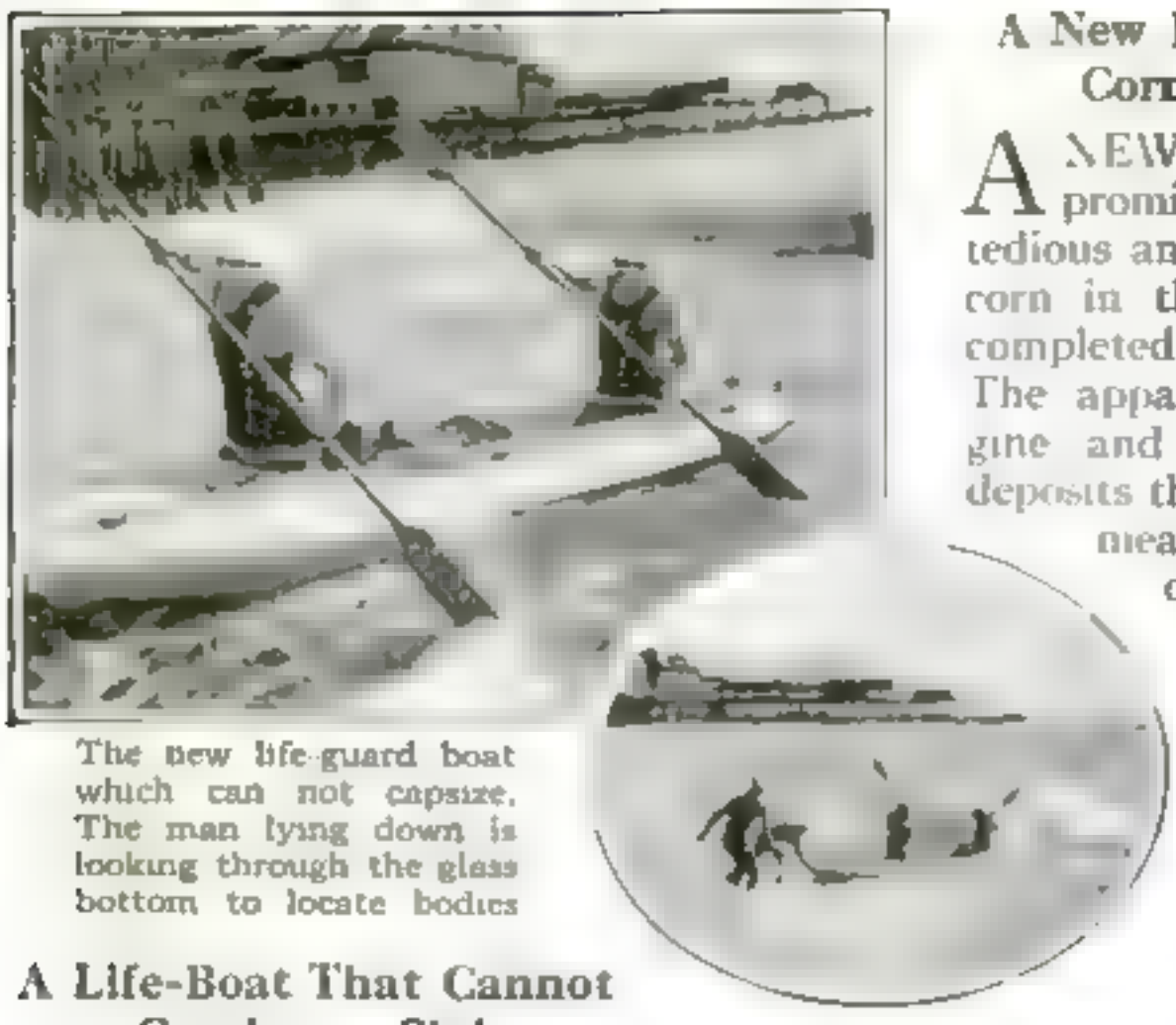
A bunch of fire-crackers to scare away the malicious spirits of storms and submarines

Fire-Crackers: A Chinese Protection Against Submarines

THE Chinese are superstitious. They are constantly trying to slaughter the myriads of malicious spirits and sprites that are supposed to flutter everywhere, even under the bed or between the cracks of a floor.

Fortunately, it is a comparatively simple matter to put a couple of thousand sprites out of the way in one fell swoop. All you need do is to explode a fire-cracker. The evil spirit and malicious sprite can't stand noise. It irritates them to distraction. If loud enough it kills them.

Consequently, when a Chinese crew makes ready to hoist anchor the first ceremony is to unpack the fire-crackers and slaughter the evil spirits with a five-minute bombardment. Nowadays great quantities of fireworks are carried.



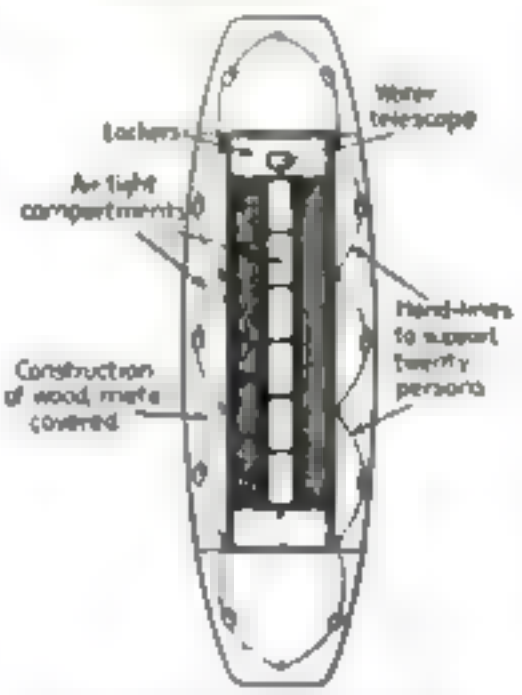
The new life-guard boat which can not capsize. The man lying down is looking through the glass bottom to locate bodies

A Life-Boat That Cannot Capsize or Sink

A NEW life-boat built along the lines of a big surf board, has proved so satisfactory that it has been officially adopted by the city of Long Beach, California.

The boat, sixteen feet long, forty inches wide and fourteen inches deep, is non-capsizable and self-draining, and is the invention of A. M. Nelsen of Long Beach. It has many advantages over the skiffs now used by the municipal life-guard squad of that city. It can be put through the heaviest surf without waiting for a calm. It has air tanks on both sides, at the ends, and down the middle, and has a glass bottom through which bodies that may have sunk may be located. With one man paddling, and the other stretched at full length peering through the glass bottom, a body can be located in twenty feet of water and brought to the surface by means of grappling hooks or by diving after it.

The boat is propelled with double-bladed paddles by two guards. It can make a speed of six miles an hour, and will support twenty people.



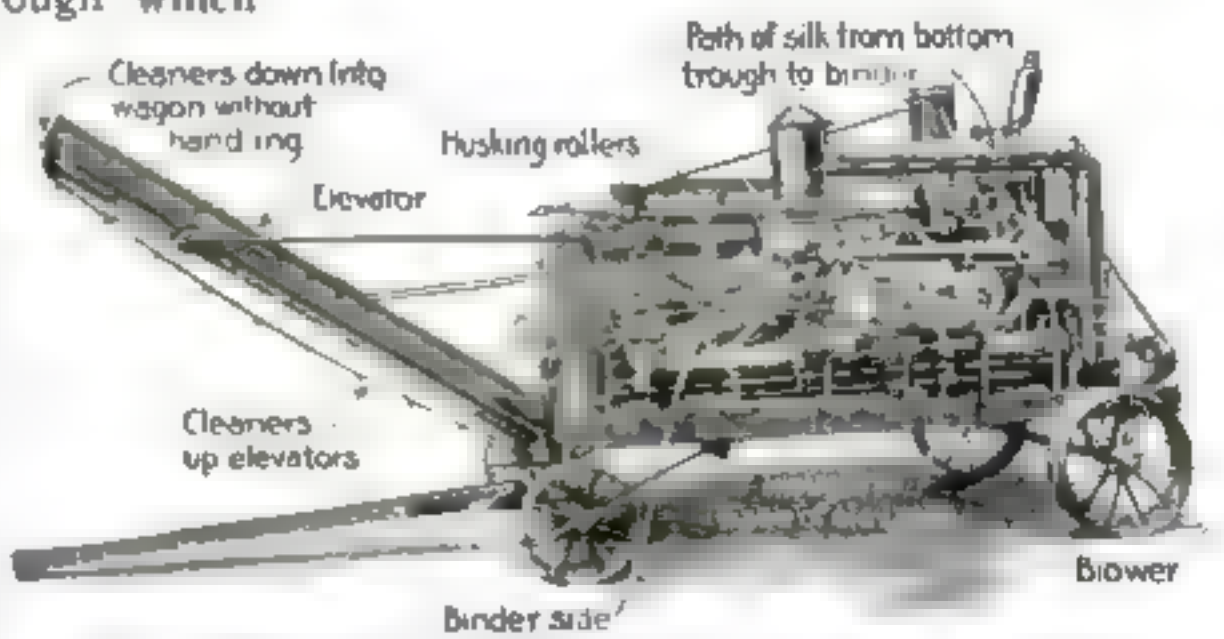
The buoyant air tanks are at both sides, at the ends, and down the middle. Above: Launching the boat in a heavy surf

A New Machine Husks a Bushel of Corn a Minute in the Field

A NEW type of corn husker which promises to relieve the farmer of the tedious and disagreeable work of husking corn in the damp fields has just been completed by W. H. Tschantz, of Ohio. The apparatus is driven by a gas engine and not only husks the corn but deposits the clean ears in a wagon bin by means of an elevator forming a part of the device and binds up the husks and silks in bundles like wheat, eliminating all litter and loss.

The apparatus consists of a small four-wheeled wagon on one end of which are mounted the gas engine and a suction blower, with the husker and binder at the other.

In operation the wagon is drawn from shock to shock by horse or mule power. The unhusked corn is deposited on one side of the binder. The shock is first torn into small bundles and thrown on the feed board, which carries the bundles up to a series of horizontal rollers. Most of the husk is removed while passing through these rollers, and the ears are dropped on to a pair of rollers beneath the husking rolls. Here the silk is removed, after which the clean ear drops through a trough into the base of the elevator, which deposits them in a wagon or other waiting receptacle.



The bundles of corn are thrown on the feed board which carries them to a series of rollers which remove the husks

French Official Photo

Millions of shoes worn to all degrees of disrepair, waiting to be sorted, patched and soaked in oil. Scraps of leather are passed through an ingenious cutter and converted into boot laces

The "Shoe Hospital" of the Allies. Not an Inch of Leather Is Wasted

IN a recent issue of *The New Republic*, W. M. Meredith makes the following reference to the shoe-repair shops of the Allied Armies.

"Entering another shop we find huge stacks of worn-out boots in every degree of disrepair. These are first sorted out like patients in a hospital, according to their various injuries. Those requiring new soles go in one direction, those which must have new toes or sides are passed on in another. Here the boots are refitted completely, and finally go into a bath of hot oil where they are thoroughly soaked. If any British soldier of the three million or so in France expresses a wish to have a certain pair of boots returned to him that fit him with comfort, he is certain of getting that same pair back." Think of that in connection with our photograph above!

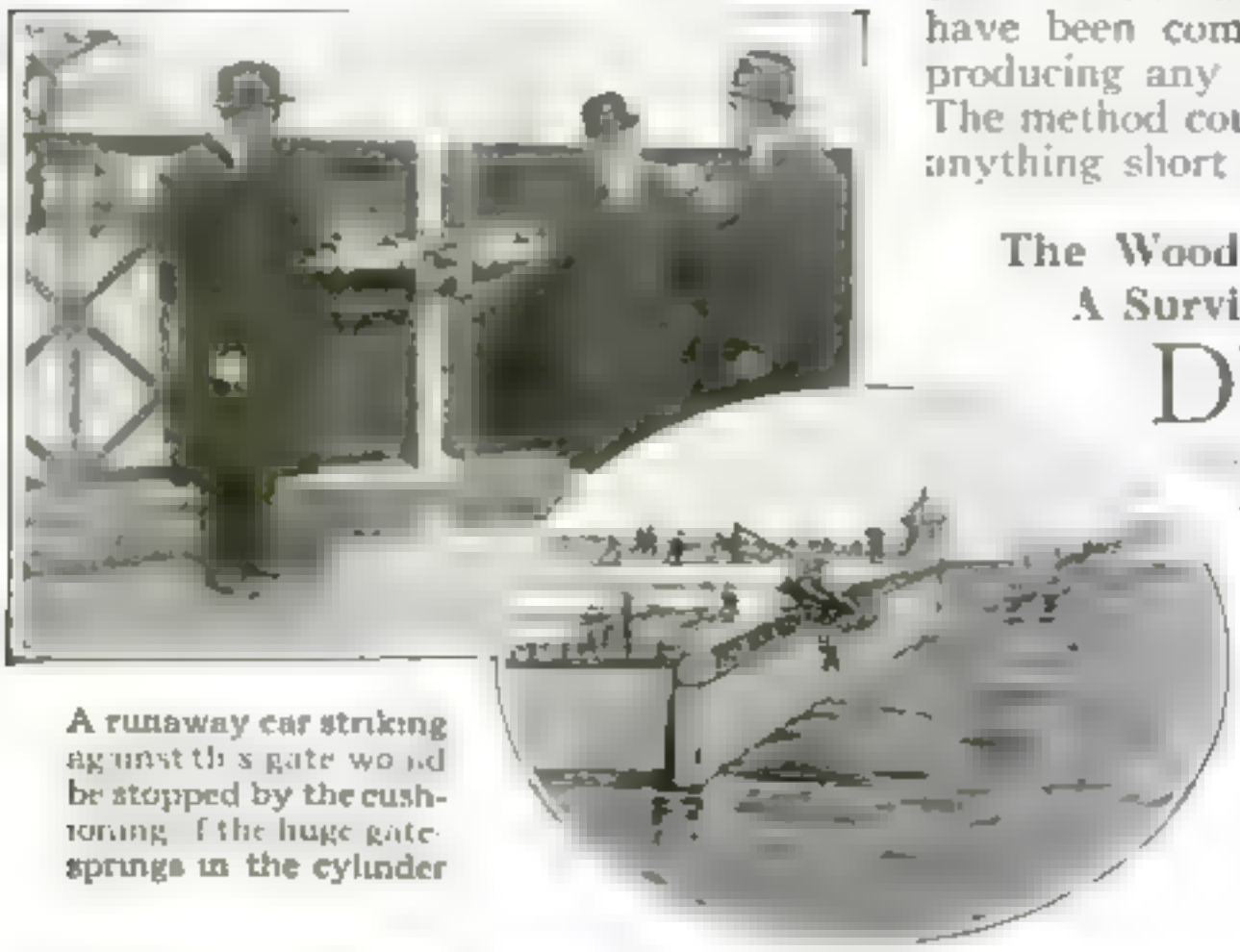
Not the Latest Style in Hats—Just a Hair-Drying Frame

THE artist who made the "human interest" drawing of the hair-drying frame illustrated below is evidently a bachelor who has spent all his days in an Eden where there were no Eves to go about periodically in low-necked kimonos and wildly flowing tresses during the process of drying and airing the hair after a shampoo.

However, he has shown the frame clearly. It is made of wire netting, and buckles around the head with an adjustable band. The hair is drawn up tight to the crown of the head after the last rinsing and a perfunctory drying. Then the frame is adjusted and buckled around the head, and the hair is spread over it in all directions, so that the air can circulate through it thoroughly. To the professional hairdresser, with an electric fan for the drying, such a frame should prove invaluable.

The hair-drying frame is of wire netting with an adjustable head band

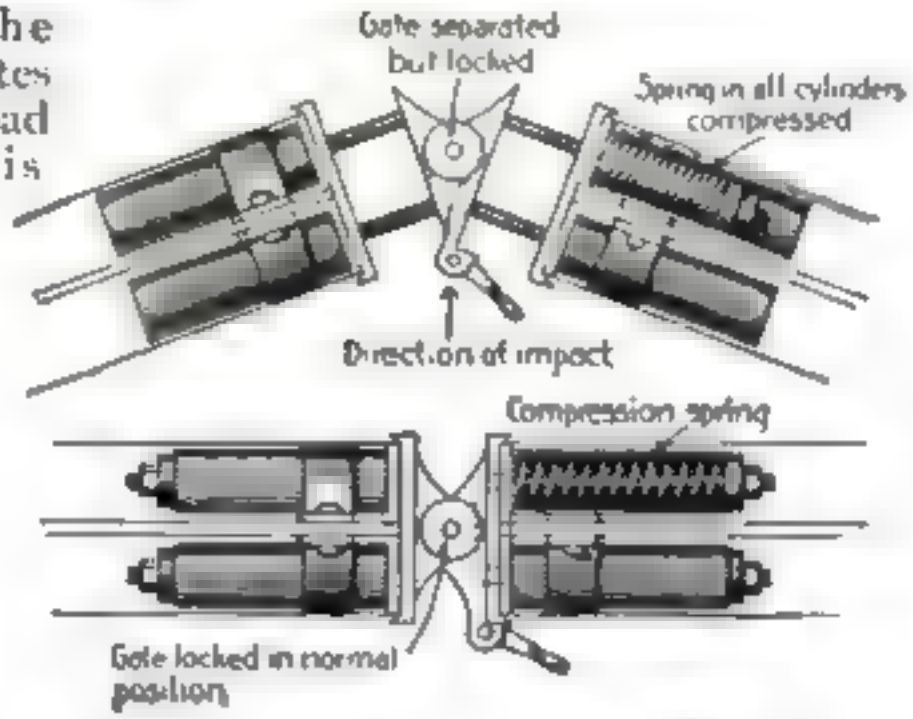
A Drawbridge Gate Which Will Stop Any Automobile



A runaway car striking against this gate would be stopped by the cushioning of the huge gate springs in the cylinder

DESPITE even the massive iron gates that swing across a road when a drawbridge is opened, automobiles break through occasionally and plunge into the river below. Such accidents occur when the brakes jam

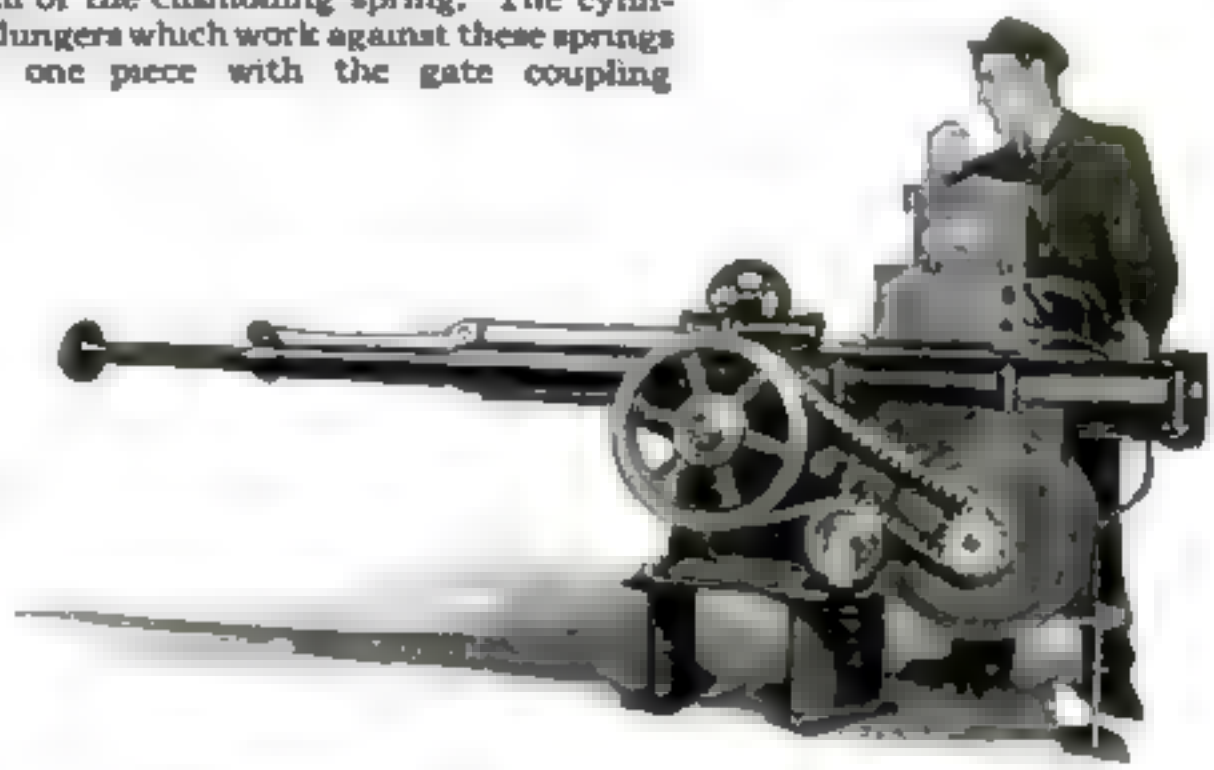
Here was an opportunity for an inventor. It was seized by Jacob Harsen, a highway engineer of New York, who has invented a cushion lock for gates. Four huge "locomotive" springs are mounted inside of four cylinders at the ends of the swinging gates on each side. The cylinder plungers, which work against these springs, form one piece with the gate coupling, which is locked by the gateman when the drawbridge is about to be closed. When the automobile strikes the gate at high speed, the huge springs are slightly compressed; then the gate "gives" away gradually. The energy of the automobile's impact is still further absorbed as the spring is further compressed. Before the car has gone a half dozen feet forward, all of its "push" will have been completely destroyed without producing any undue strains on the gate. The method could be relied upon to stop anything short of a railroad train!



Detail of the cushioning spring. The cylinder plungers which work against these springs form one piece with the gate coupling

The Wooden Hand Rammer — A Survival of the Fittest

DURING the last five years the electric chain rammer has disappeared from the turrets of modern warships. A short circuit on one of the battleships almost led to disastrous consequences. In other cases a temporary breakdown spoiled the turret's chances in record firing. Gradually the old hand rammer, which in principle has changed little since Nelson's men rammed the round shot home in the muzzle loaders, has won back its supremacy. The turret of a Dreadnought is filled with other electrical devices, but the wooden rammer is the one bit of equipment that has survived from the days of wooden ships, so far as the turret is concerned.



The electric chain rammer was placed directly in the rear of and parallel to the bore of the turret gun

Our Unsinkable Torpedo-Proof Cargo Fleet

The boats will be patterned after the ordinary oil tanker with its hull divided into a dozen or more tight compartments

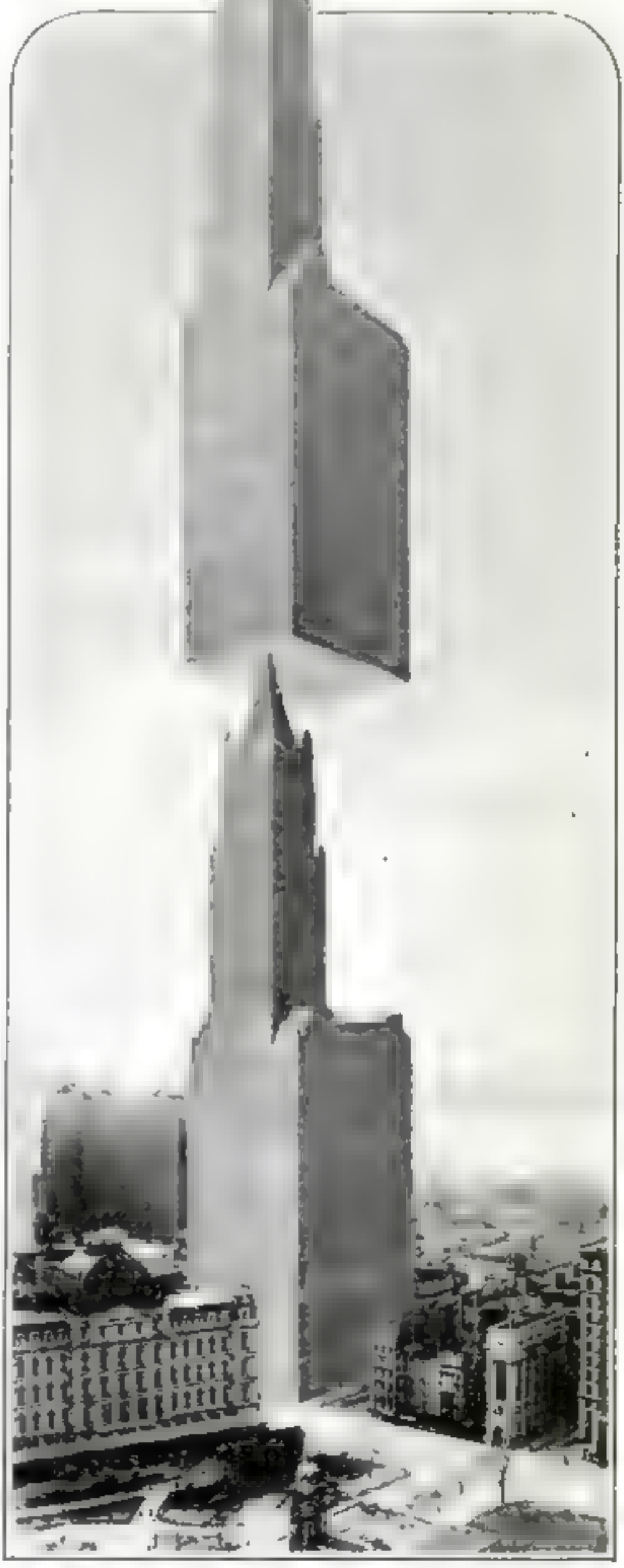
By Joseph Brinker

UNSINKABLE? Yes, practically. That's the kind of ships it is now proposed to build for Uncle Sam's fleet of freighters to thwart the torpedoes of the German submarines. Of course no vessel afloat or to be launched in the near future will be unsinkable if a sufficient number of torpedoes are exploded against her sides. Even the latest battleship is not immune. But Uncle Sam's new boats will have no unprotected portions of the hulls, and it will take at least two and perhaps three well-aimed torpedoes to sink one of them.

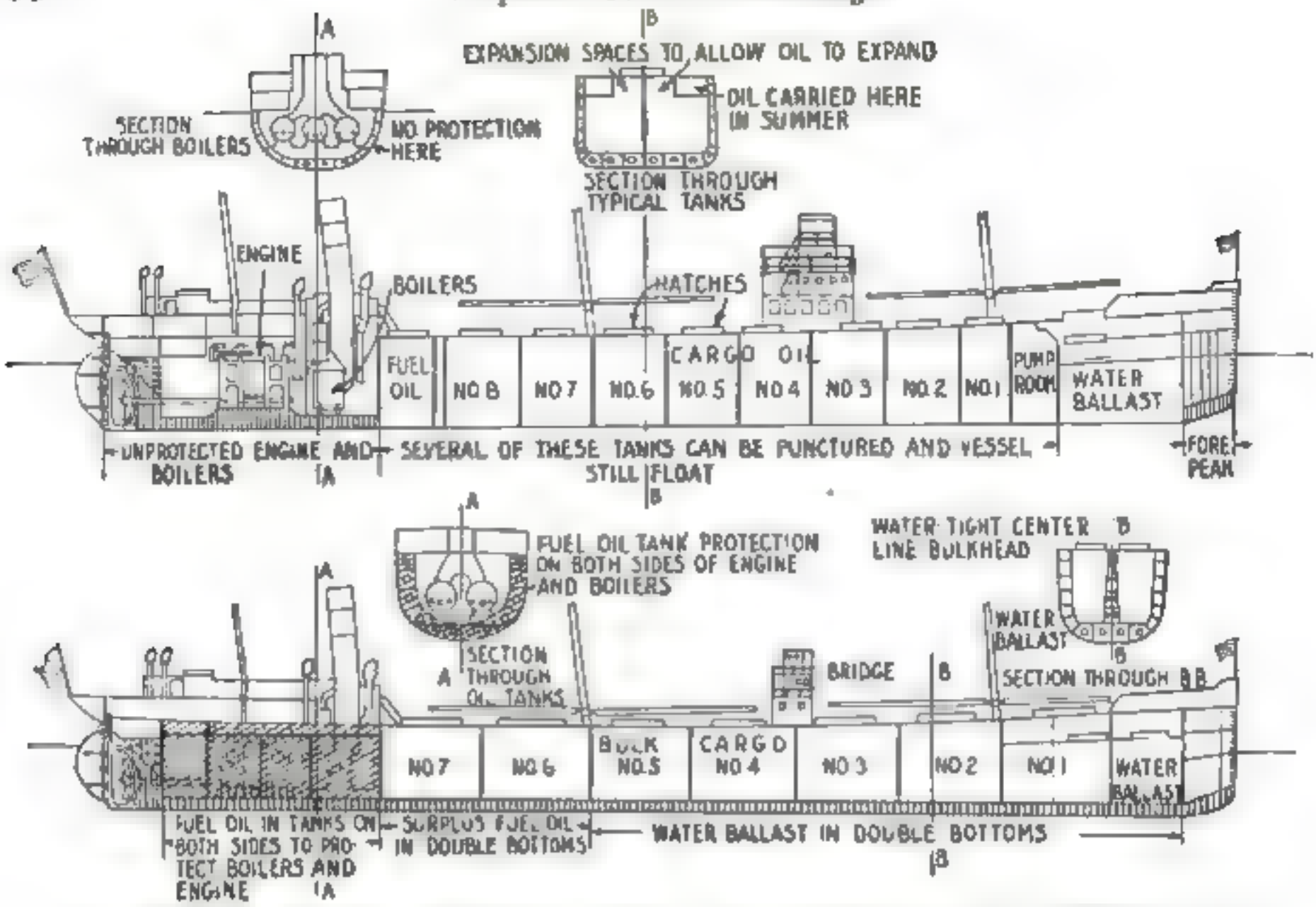
The new type will be fully armed. It will be of steel construction and patterned after the present-day oil-tanker which is practically immune against single torpedo attacks except in the way of the engine and boiler rooms. If struck there she is done for and settles by the stern, with no power to proceed. The new boats will have fuel-oil tanks extending clear around the ship from main deck to main deck, from the front of the boiler space to the rear of the engine room. If a torpedo strikes her there and blows a hole in her outer skin, the inside of the tank will act as a new hull to keep her afloat until the submarine rises to view her prey. Then because of her armament, the ship has a chance to destroy the submarine. None of the oil tankers have been sunk so far in the war by one torpedo, unless hit in the engine or boiler space.

Applying the Lesson Taught by the Oil-Tanker

The bulk oil in the tankers is carried in a dozen or more separate tanks or compartments into which the hull of the tanker is divided by an oiltight longitudinal centerline bulkhead and many transverse bulkheads. This is why one



A billion dollars' worth of shipbuilding means that the proposed ships will entail the production of steel enough to make two Woolworth Buildings, each 792 ft. high

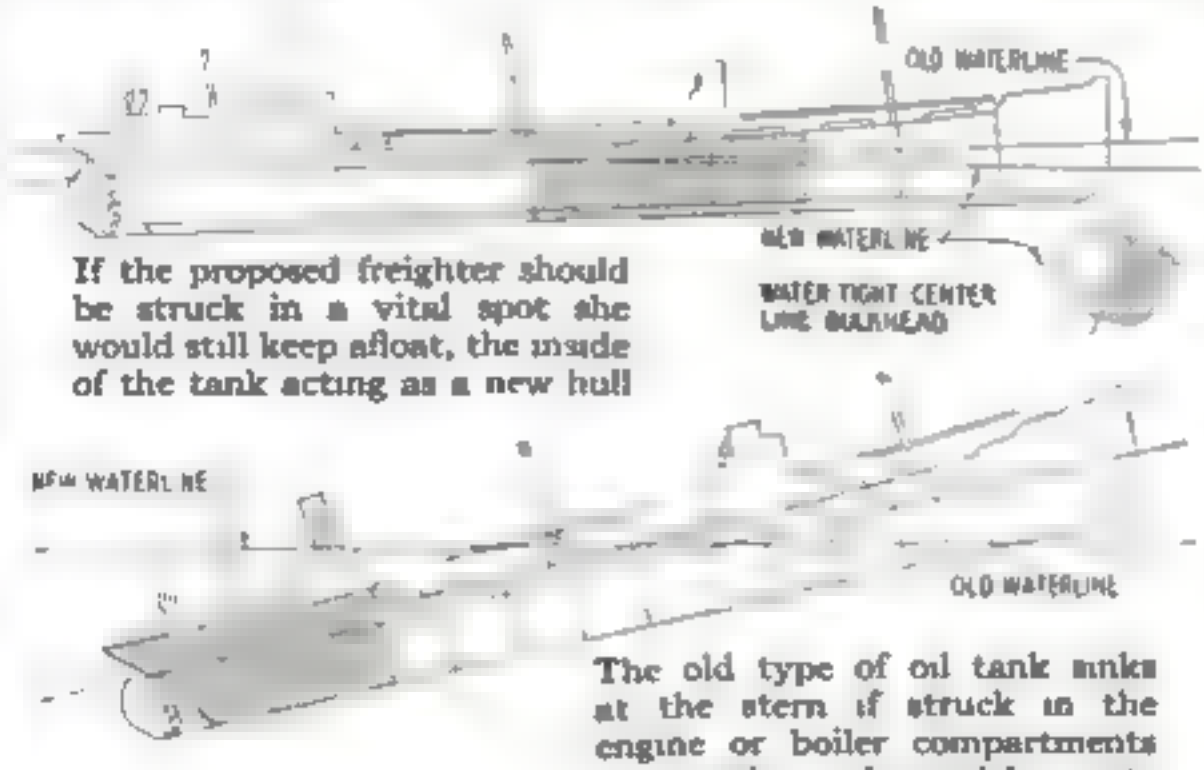


The typical oil-tank steamship shown in section at the top and the proposed freighter beneath it indicate the great similarity between the two types. The oil tanks are practically made over into cargo holds. The small transverse section of the boiler and engine room of the upper diagram shows its vulnerability to torpedo attack in that portion of the ship. The lower diagram shows how the vitals in a similar section of the proposed ship will be protected by means of fuel-oil tanks

In the proposed freighter, the hull will be divided into a dozen or more small compartments and the engines and boilers will be protected by means of fuel-oil tanks extending clear around

torpedo will not sink her. A torpedo exploding against the hull of the ship and crushing one or two of these compartments does not sink the ship because of the relatively small size of the few compartments punctured, compared with the remaining dozen or more that are left intact.

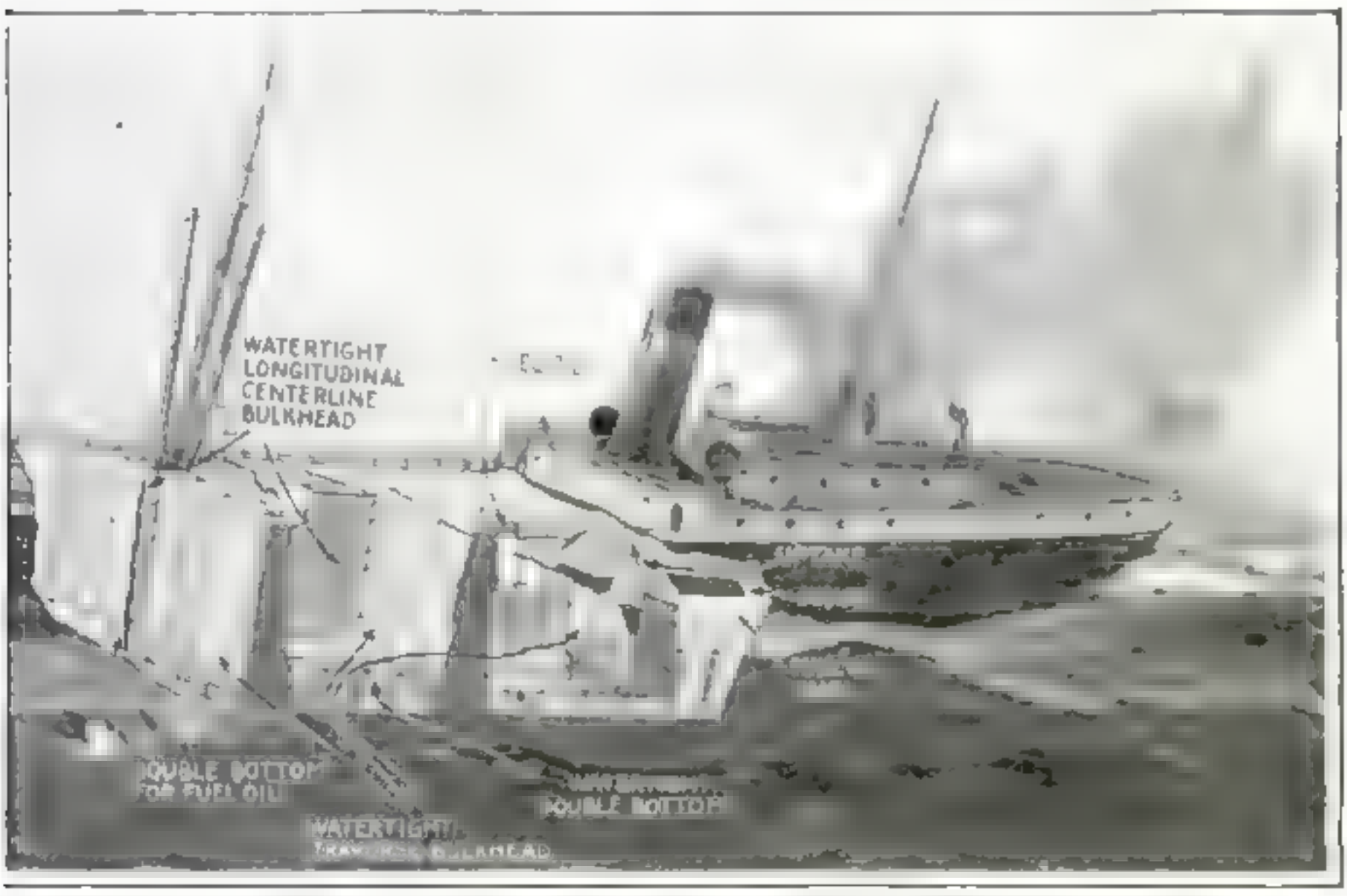
The reason that one torpedo is not liable to break open more than two or three of these tanks is that a torpedo is in no sense an armor-piercing shell which passes through the boat from one side to the other or explodes inside, blowing everything apart. On striking a vessel's side it explodes and does its work by the rapid expansion and concussion of the gases of its charge.



If the proposed freighter should be struck in a vital spot she would still keep afloat, the inside of the tank acting as a new hull

The old type of oil tank sinks at the stern if struck in the engine or boiler compartments —its only vulnerable spots

The majority of the new boats will be of steel and not of wood as first planned, and illustrated and described in the June issue of the POPULAR SCIENCE MONTHLY. They will be of steel because there is still some skepticism as to the practicability of the 3000- or 5000-ton wood vessel, because such a ship has never been built before. Questions have arisen as to the racking stresses and strains which would be set up in a ship by the use of unseasoned wood and as to our ability to raise a sufficient army of shipbuilders to carry on the work. All of these arguments and the facts that wood ships would probably have shorter lives than steel ones and be at a disadvantage in competing with the steel ships of other nations after the war, seem to have killed the wooden fleet proposition. Besides, there is no longer a shortage of steel.



the ship. In the broken-away portion of the drawing the bulkheads dividing the space into compartments to reduce the crushing effects of the torpedo's explosion are very clearly shown

A German Medal to Commemorate the Torpedoing of the Lusitania

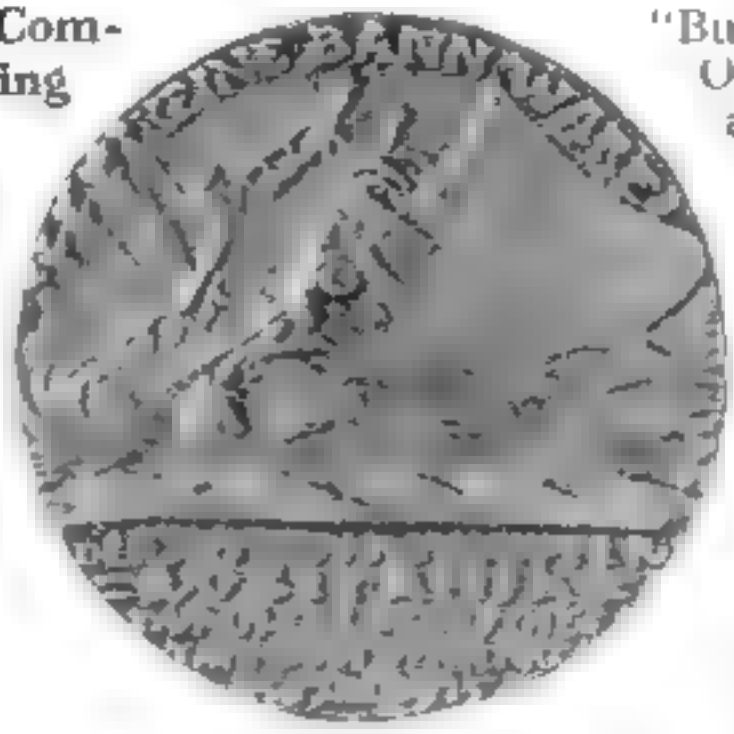
THERE came into the office of POPULAR SCIENCE MONTHLY recently a bronze medal in a leather case. It was one of the two medals struck off by the German Government in commemoration of the act that, more than any other, inflamed the American people against Prussianism, the torpedoing of the Lusitania. To further celebrate the event the school children of Germany were granted a half holiday and the commander of the submarine was decorated by the Kaiser.

One medal (not shown here) depicts Neptune seated on a submarine shaking his fist at a sinking ship. On the opposite side is a bas-relief of von Tirpitz. The second medal, which is reproduced here, shows, on one side, the Lusitania sinking, and on the other the figure of Death selling tickets at the office of the Cunard Line.

The three German words above the sinking ship stand for "No Contraband On Board." Examine the illustration and you will see that a cannon and an airplane occupy the deck. Although the Lusitania carried rifle cartridges on her fateful trip, it has been indisputably proved that she carried no weapons of defense or offense. Needless to say, the cannon and airplane are pure inventions. Translated, the legend beneath the ship reads: "The steamer Lusitania sunk by a German submarine May 5, 1915." Note that the date is given as the fifth of May instead of the seventh. Is the error a deliberate one?

At the top of the lower illustration appear the words, "Business Above Everything." One person is shown reading a newspaper, evidently the advertisement inserted by Count von Bernstorff, warning Americans and other neutrals to keep off vessels flying the British flag. Note the man in the rear with the menacing finger upraised; also the care-free attitude of the two men in front of him. Beneath the window, in which Death is selling tickets, appear the words, "Ticket Office."

In all, 1,198 passengers and crew lost their lives on the Lusitania. In this number are included 124 Americans and 94 children.



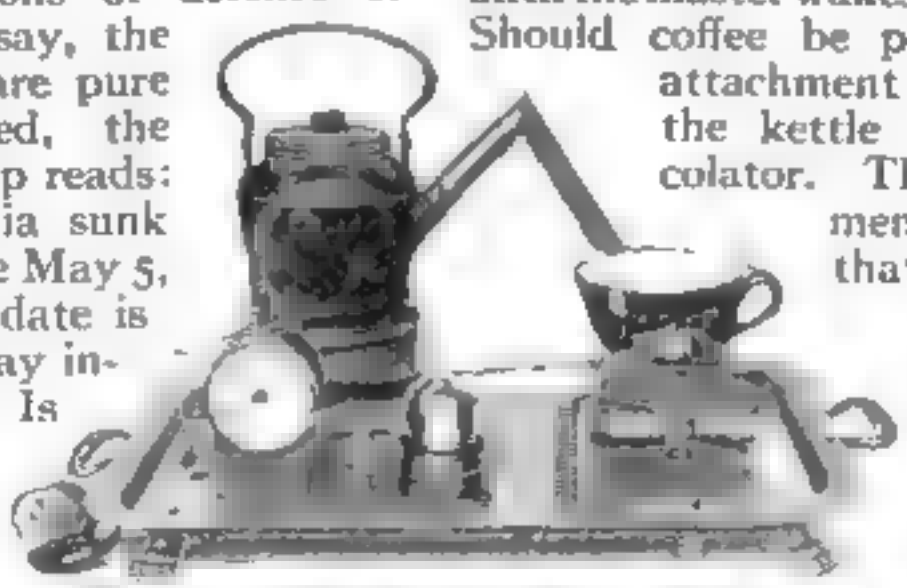
Full size illustrations of one of the German medals which commemorate the sinking of the Lusitania

An Automatic Tea-Making Machine

"BR-R-R-R! ting-a-ling! Wake up! Your tea is ready. Br-r-r-r! Time to get up!"

This is practically what the automatic tea-making machine does every morning. It brews a cup of good tea, and then it calls its master. It was invented by a young Englishman, George Weddle, of New York, and was designed especially to call him and serve him with his morning bracer.

The machine consists of an electric stove, kettle, alarm clock, electric bell, battery and tea cup on a tray eighteen by ten inches. With these it brews the cup of tea, pours it into the cup and rings a bell until the master wakes up and takes his tea. Should coffee be preferred, there is an attachment to be screwed into the kettle that will act as percolator. There is also an attachment for boiling eggs, so that an automatic breakfast, cooked and served at your bedside, seems quite possible. The machine may be easily taken apart and put into a small hand bag or traveling case.



The tea making machine brews the tea, pours it into a cup and rings an electric bell

California's Conception of a "Tank"

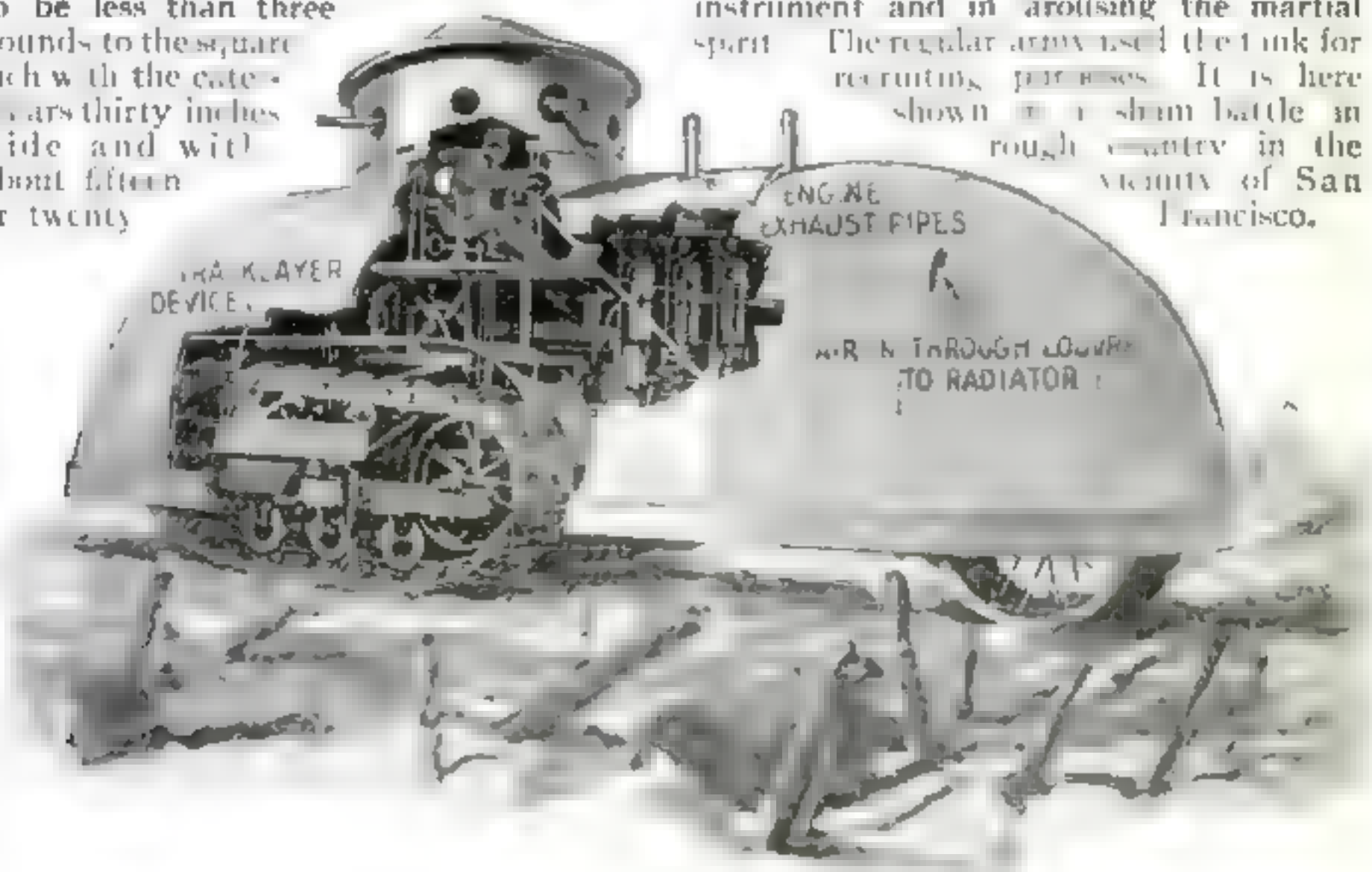
It was designed for aid in recruiting

PATTERNED somewhat after the famous British tanks pictured and described in the May issue of POPULAR SCIENCE MONTHLY, the California-made tank shown herewith is like its famous prototype in only one particular, that of a track-laying propelling means. There the similarity ceases, for it has not the large upswept track-laying framework in front that has made possible the almost incredible hill-climbing feats of the British tank. Instead it has two track-laying members of the kind used on farm tractors and a small guiding wheel in front.

A company of infantry using the track-laying tank in sham battle on the outskirts of San Francisco

Formidable as it looks in armor and with the guns sticking out of its turret, a heavy rain would render it useless in actual service. The small wheel in front would bury itself in soft ground on a shell crater, which its foreign rival could negotiate with ease. The large bearing area of the caterpillar shoes makes it possible for the British tank to traverse soft, muddy ground. The pressure is said to be less than three pounds to the square inch with the caterpillars thirty inches wide and with about fifteen or twenty feet of length in contact with the ground all of the time

Obviously, then, the truck illustrated would be a failure in the land of shell craters between the trenches in warfare as carried on to-day. However, it served a useful end in acquainting our California infantry with its adaptability as a war instrument and in arousing the martial spirit The regular army used the tank for recruiting purposes It is here shown in a sham battle in rough country in the vicinity of San Francisco.



Because of the small wheel in front, the tank could not travel in a land of shell craters and muddy ground. It is, therefore, not in the fighting class, however formidable it may appear

Portion of a motion picture taken through periscopes at the bottom of the sea in the crystal-clear West Indian waters

Seeing the Wonders of the Ocean Through an Inverted Periscope

AS is well known, the periscope enables the submarine, while submerged, to see above the surface of the water. Why not invert the periscope, attach it to the side of ocean liners, and thus enable the passengers to study marine growths and fishes? Provided there was sufficient light beneath the water, the inverted periscope might even be used to search for sunken treasure!

This is exactly the use to which it is put in the latest underwater motion picture film of the Williamson Brothers, "The Submarine Eye." It will be recalled that the thrilling underwater scenes in "Twenty Thousand Leagues Under the Sea," were photographed by the Williamsons. In "The Submarine Eye," the new under-sea thriller, the inverted periscope, as shown in the illustration above, is used to locate a safe containing treasure. In the crystal-clear waters of the West Indies the audience is shown the marvels of Nature at the bottom of the sea where the light from above is reflected from the dazzlingly white sand. Finally, after a series of harrowing adventures many fathoms under water, the safe is located by the inverted periscope.

Importing Japanese Mosquitoes for Bird Food

THE delicate vocal organs of song birds respond magically to special care bestowed upon the diet. For this reason birds that are cultivated in captivity are fed specially prepared foods designed to furnish maximum nourishment with minimum labor of the digestive organs.

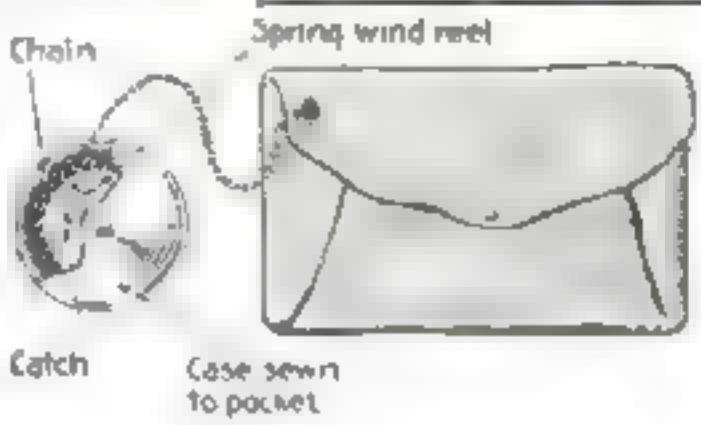
A food which has been found especially valuable to bird-breeders has for its principal ingredients Japanese mosquitoes and ants' eggs. It is prepared by George Jenkins, of New York city, an expert on the care and feeding of birds. The nationality of the mosquitoes is not supposed to make a difference in the taste or digestibility of the food. The reason the insects are imported from Japan is that the Japanese have a method of catching them in large quantities which as yet Americans have not discovered.

In the photograph below, Mr. Jenkins is shown inspecting a shipment of twenty-eight pounds of mosquitoes. The food is intended for soft-billed birds that do not feed on seeds. Among these are the thrushes, mocking birds, nightingales, tanagers and many others. In the oval photograph an American thrush is shown feeding her nestling with the prepared food. She takes the food on her bill and thrusts it far down the youngster's throat.

Twenty-eight pounds of Japanese mosquitoes to be used as an ingredient in the bird-food

Shall Personal Vanity Prove a Handicap to the Government?

BECAUSE Dame Fashion, in one of her capricious moods, has decreed that platinum jewelry is the fashionable thing to wear, that metal has steadily advanced until to-day it is worth five times as much as gold. As a result all chemical laboratories and institutions throughout the country are greatly handicapped by its scarcity. For producing sulphuric acid, which is an absolute necessity in the production of high explosives, platinum is essential. To relieve the present condition the American Chemical Society suggests that the loyal public refrain from purchasing platinum in the form of jewelry and discourage the use of the metal for ornamental purposes. This would be in line with economy, also.



This safety chain can be used for securing a wallet to a man's pocket or to a lady's handbag

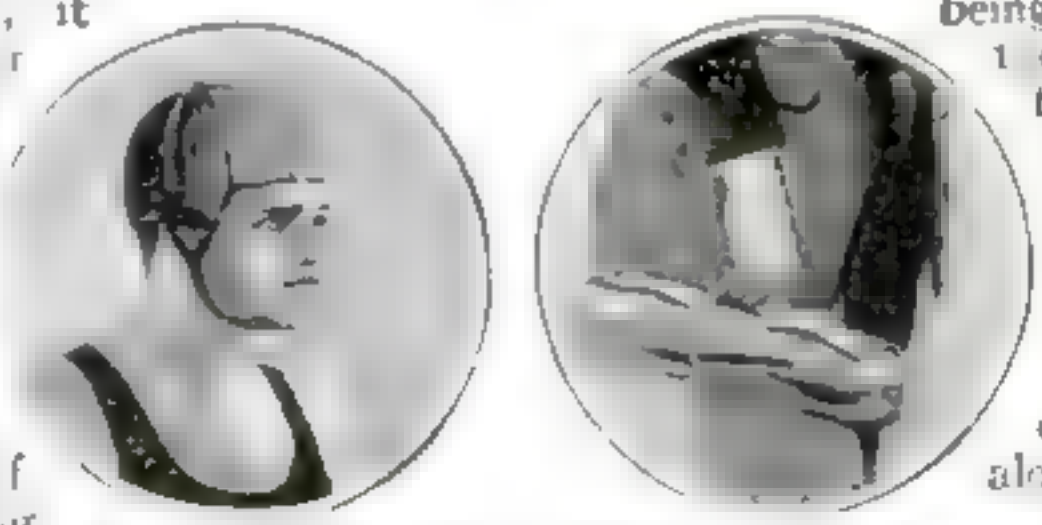
The steel chain is wound up on a spring-revolved drum when the wallet is pocketed

The Many-Sided Bathing Cap. Change It to a Suit-Bag When You Travel Home

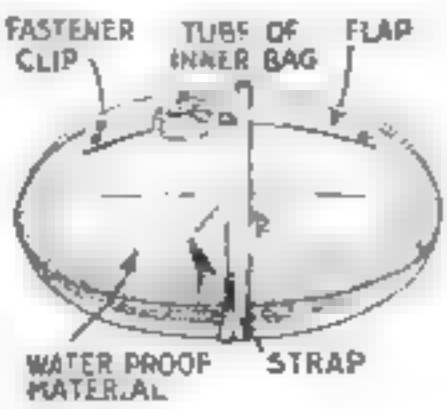
THE convertible bathing-cap of a New York merchant has many virtues. Inflated, it serves as a waterwing or a football. Deflated, it becomes a wrapper in which to carry your bathing suit.

The cap is made from strips of waterproof material sewed together to a football's shape. It can be folded in half lengthwise by pushing one end down into the hollow of the other end. When this is done it will conform to the shape of the head and it will be ready for use as a cap. Straps are attached to the side for securing the cap under the chin.

A circular bladder can be placed inside this same piece of goods and inflated to change it into a ball for playing on the beach. With a bladder of different shape placed inside it, it can be used as a waterwing with straps to fasten it around the body.



This cap when opened out forms a bag for the bathing suit. When inflated it is a rubber ball



At Last!—The Safety Chain for Frustrating the Pickpocket

FROM sad experience, many a man has learned that placing his wallet in even an inside pocket will not prevent it from being stolen. But if the wallet is attached to the safety chain invented by Lawrence R. Delaney, of Gage, Oklahoma, a pickpocket could not remove it without taking the coat along, too!

A fine steel chain connects the wallet with the coat pocket. When you pocket your wallet, this chain is wound up on a spring-revolved drum in a very thin casing which is sewed to the bottom of the pocket. The chain, which has its free end secured to your pocketbook, is about a foot long, so that you can draw it out conveniently. When you return the wallet to your pocket the chain winds up automatically. Should a pickpocket attempt to rob you, the tug on the chain would betray him.

Fifty Million Shots to Win a Line of Trenches

Nearly nine million pounds of artillery projectiles were hurled at the Germans in a single engagement

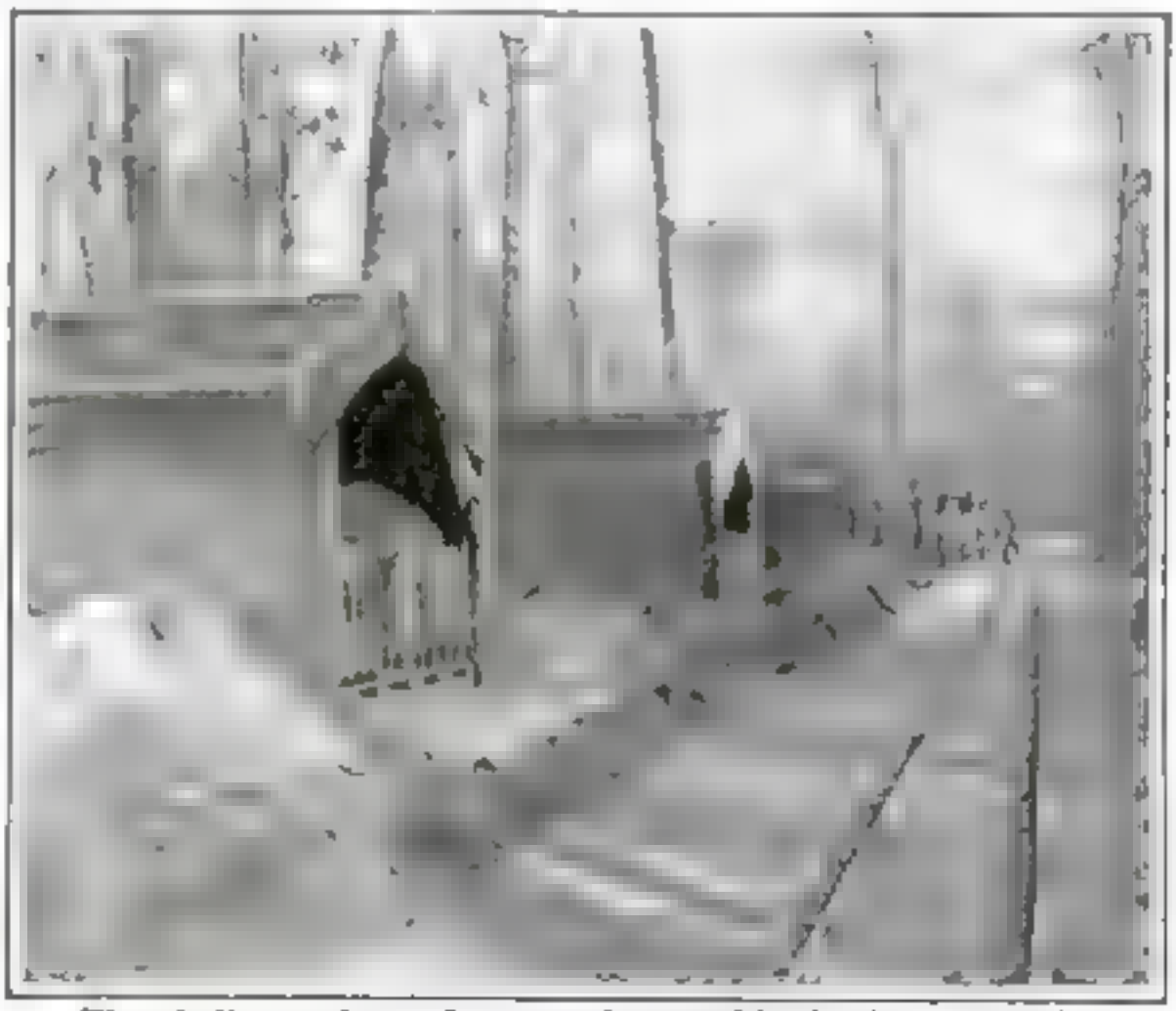
French Official Photos.

Thousands upon thousands of cases of shells are unloaded at the artillery depots of the various armies, after which they are transported in smaller lots to distributing stations

IN the early days of the war, when the Germans were turning out 250,000 shells a day, the British were producing 2,500 in high explosives and 13,000 in shrapnel. Before the war, Germany held an average stock of 3,000 shells for each gun, while France had 700. When the war began, France estimated a daily expenditure of 13,500 shells, but before a year had elapsed, she was firing 100,000 a day.

According to an official report of the French Army Headquarters, the French artillery north of Arras fired 300,000 shots within 24 hours, the total weight of which would be 8,901,000 pounds. During the great French offensive of September, 1915, in the Champagne, the French fired at the rate of 900,000 shots an hour—a total of 50,000,000 shots in three days on a twenty-five-mile front.

The cost of ammunition, considered in the light of its wastefulness, is appalling. A year ago, Canada had contributed $350,000,000 worth of shells. The United States had exported ammunition, explosives and firearms worth a half-billion. It is needless to state that the last year has been the most productive of all, not only in the United States and Canada, but in European countries as well. Figures of shell production run into unthinkable billions. For this the tremendous capacity of the guns used is largely responsible.

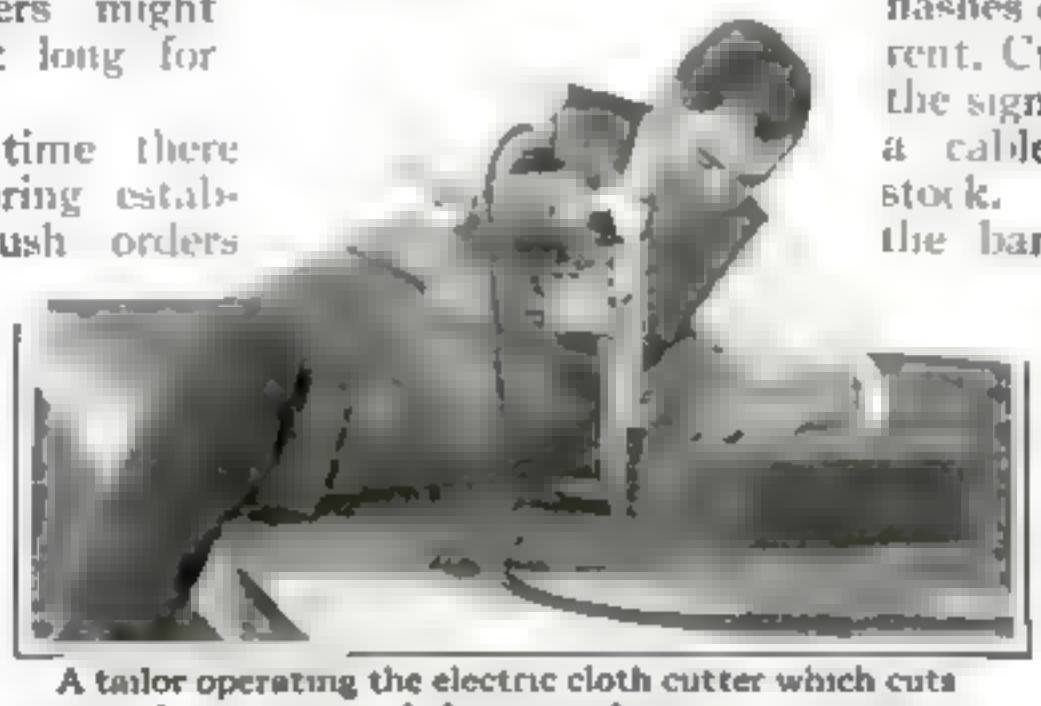


The shells are housed in rough portable shacks arranged in rows along narrow-gage tracks which lead to the fighting front

Cutting Forty Soldiers' Uniforms At One Time

WITH the aid of an electric cutting machine one tailor can cut forty soldiers' uniforms at one time, and in one day do the work of one hundred men working with shears. Were it not for the many labor-saving machines in the tailoring business our soldiers might be obliged to wait long for their uniforms.

At the present time there are many big tailoring establishments filling rush orders for suits for the Government. They are working twenty-four hours a day, with two shifts of workmen, in order to turn out the work on time. The suits are made according to standard measurements and there is no chance to deviate from the regular sizes.



A tailor operating the electric cloth cutter which cuts out the pattern of forty uniforms at one time

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Flashing Signals from Electric-Light Guns

A NOVEL signal gun has been devised by the United States Navy to transmit visual signals between ships in a fleet of war vessels that are running without lights, and yet not betray their presence to the enemy. Signals flashed by it are visible only to the ship at which it has been aimed or one in line with it.

© N. G. Moser

"Shooting" signals with the signal gun. The flashes are visible only to the ship at which the device is aimed

It resembles the crude weapons used in the early days of gunpowder and is operated from the shoulder. It has a barrel in the form of a tube about five inches in diameter, at the base of which an incandescent electric light is located. It is fitted with a stock and there is a trigger which connects with a switch that flashes on and off the current. Current is supplied to the signal gun by means of a cable that enters the stock. On the top of the barrel are sights for aiming the gun. Signals are flashed by the dot and dash system, short flashes indicating dots and longer ones, dashes.

Visual signaling between ships at night is usually done by means of lights hung from the masthead, but their operation betrays the presence of the fleet to enemy ships that may be near by. The flashes from the signal gun are only visible to the ship at which the device is aimed or one that may be in line with it either closer or further away from the ship from which the signals are sent.

Even though no lights may be showing, one ship knows the approximate location of every other ship when they are in fleet formation and the signal gun may be aimed in the direction of any one of them.

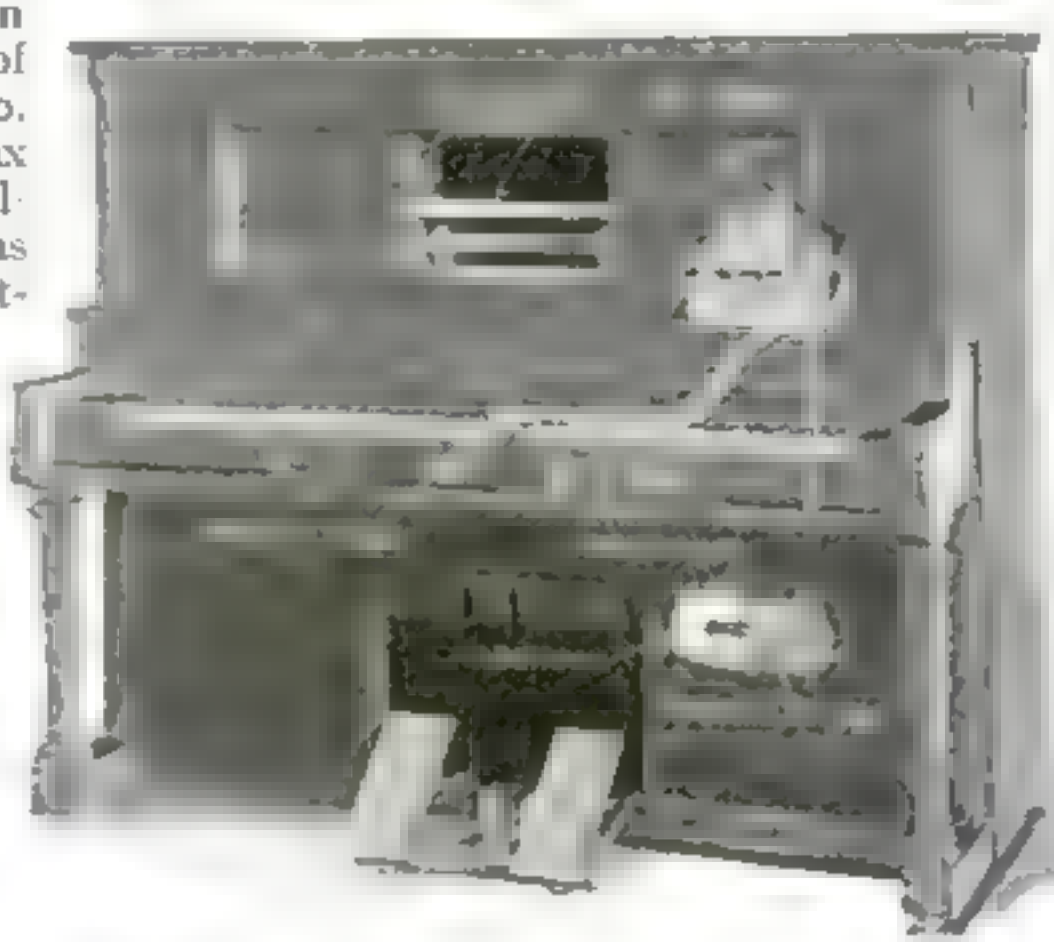
When the signal gun is used it is not necessary to "call" a vessel before sending a message. Knowing that the flashes are not visible to any other ship in the fleet, the men on watch on the bridge of the vessel at which the gun is aimed are in readiness to record the message as soon as they perceive the flashes. The very fact that they see them proves that the signal light is directed at them and that their ship is the one for which the message is intended.

The light located within the barrel of the gun is one of great power and its flashes can be seen for a number of miles at sea, even in cloudy weather.

Utilizing Your Player Piano as a Vacuum Cleaner

THERE is no better vacuum cleaning pump than the air pump of your player piano. So thought Max Rothfeld, of Philadelphia, who has patented the dust-filtering attachment which will change your piano into a vacuum cleaner. You need only to disconnect the air pipe leading from the piano bellows, from the air motor. Insert the attachment in this, have somebody work the pedals, and proceed with your parlor cleaning. The inventor also suggests that should the air-mechanism of your piano become clogged it can easily be cleaned with his device.

The device is nothing more than a flexible hose having a wire filter mounted across a small dust chamber near its end.



A dust-filtering chamber fits in the end of a long flexible hose leading from the piano bellows. The suction created by the piano pump draws the dust into the filter

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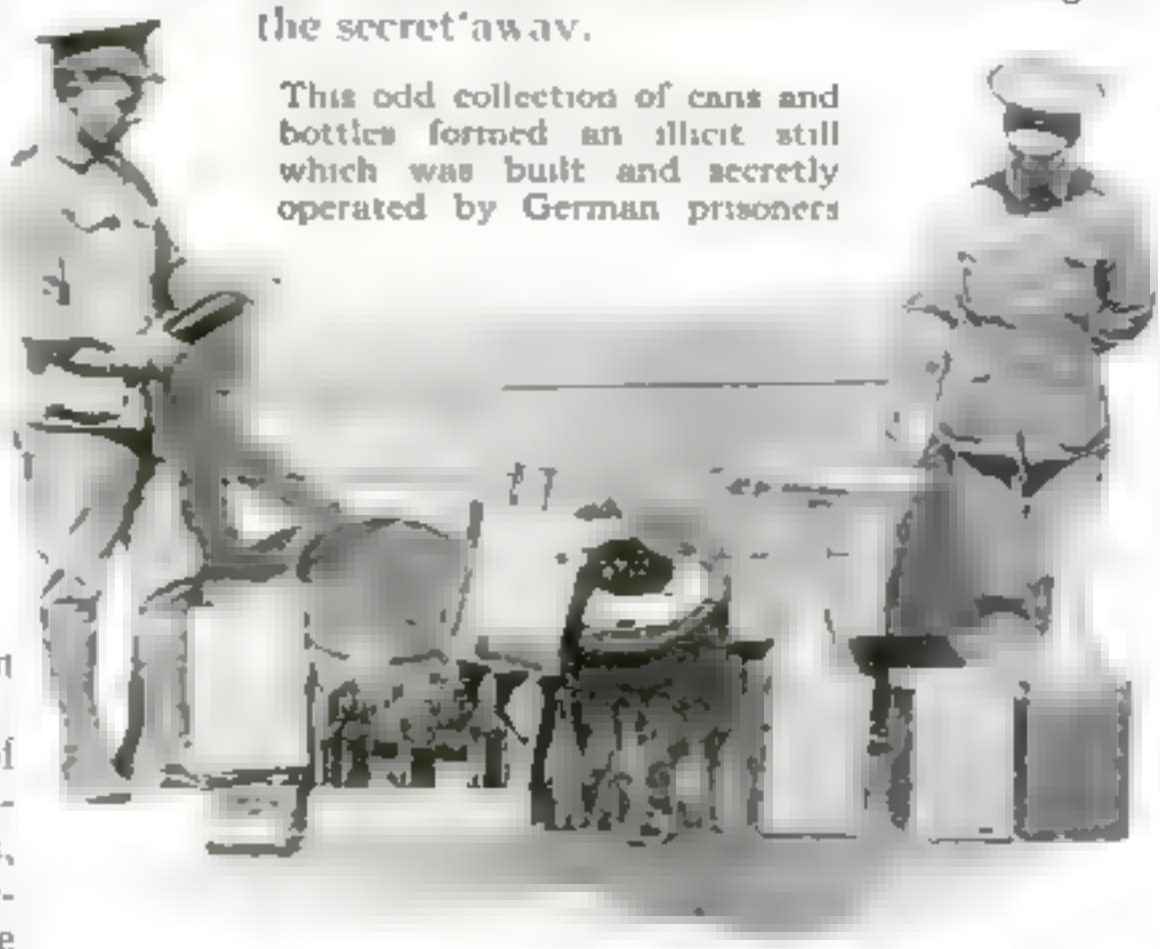
Conserving the Wheat Supply with Alfalfa

A SHORT time ago alfalfa, the clover-like plant which grows so abundantly in the West, was considered fit only for feeding cattle. Thanks to the researches of the industrial chemist, it is now destined to become one of the most important articles of human food. The present problem of the world's shortage of wheat—that well-balanced and so essential food—may even be solved with the aid of this form of "cow fodder."

Elizabeth C. Sprague, head of the department of Home Economics at the University of Kansas, has found out how a most wholesome flour can be made from the ground-up leaves of the hay of alfalfa. By replacing the all-too-scarce wheat flour with a considerable percentage of this alfalfa, a bread can be made which is far more nutritious than that made from plain wheat. The high percentage of both body-building and bone-building elements in the alfalfa makes this new bread a practically *complete* article of food. The benefits of its use will therefore be twofold: the present supply of wheat can be "stretched" to feed a far greater number of people, and a more ideal war food can be gained.

Making Bad Whiskey out of Good Jam and Potatoes

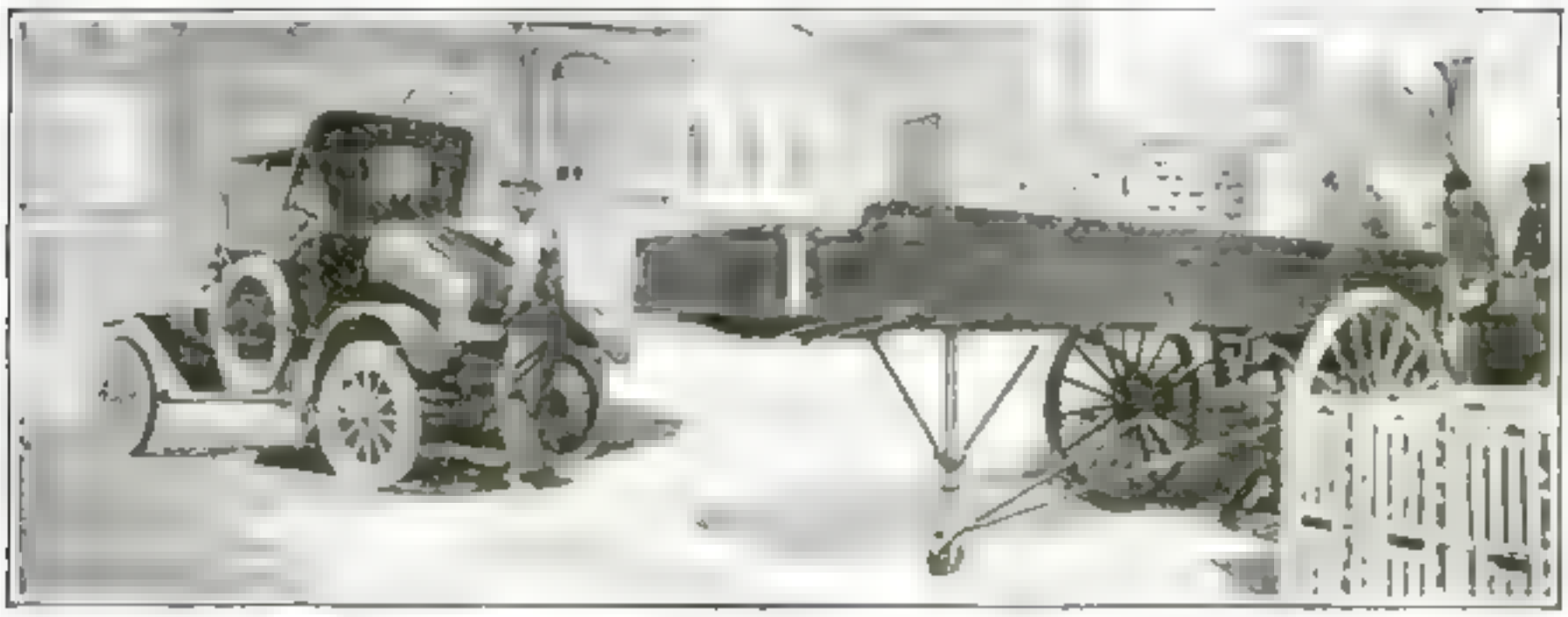
SOME German prisoners in the Holdsworthy Internment Camp, in Australia, rigged up a still of kerosene cans, bottles, tin tubes and other receptacles and made whiskey out of jam and potatoes! It was efficient enough to meet the demands of the drinkers. Perhaps it was too efficient, for the intoxicated Germans themselves gave the secret away.



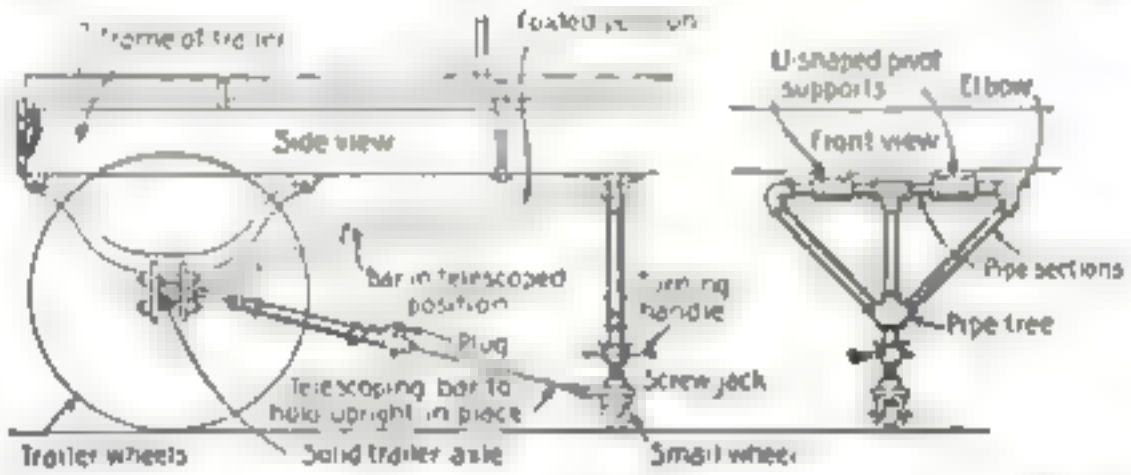
This odd collection of cans and bottles formed an illicit still which was built and secretly operated by German prisoners

Transforming a Roadster into a Truck

A device which makes it possible for a one-passenger automobile to haul three trailers



The pleasure car can be changed into a one-ton truck and back again into a passenger car in five minutes



At left: The various parts of the wagon-like trailer, showing the relation of the small wheel to the body parts

At right: The fifth wheel device mounted on the framework of the car

THE conversion of a roadster automobile into a one-ton truck and back again into a passenger car in five minutes has been made possible by the use of a patented fifth-wheel device to be set on the rear deck of the car to support the front end of a wagon-like trailer. Both trailer and fifth-wheel are now being made as a unit by a New England manufacturer to enable the owner of any roadster to change his car into a work vehicle and back again as often as desired.

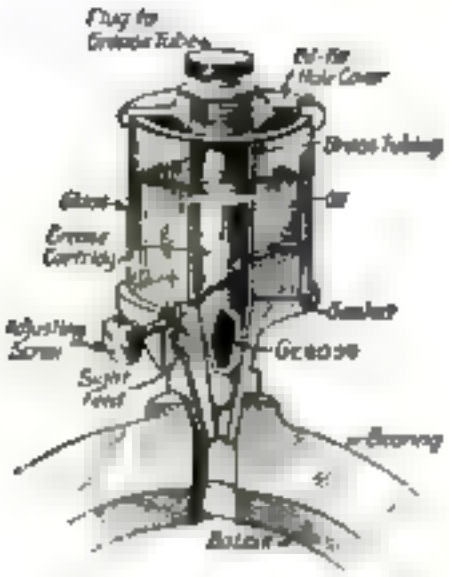
The fifth-wheel device is mounted on the framework of the car with but six bolts after the rear deck or luggage carrier has been lifted off. The device consists of two wheels of the same size which rub together, one above the other, through lubricating grease One wheel is mounted on a rocking shaft and frame attached to the car, and the other bolted to the underside of the front end of the trailer.

To connect the trailer with the car, its front end is simply lowered down on to the wheel on the car. Conversely, it may be removed by simply lifting it up by hand, if empty, or by a jack device if loaded. The fifth-wheel device, which can be lifted easily by one man, is then taken off and the rear deck replaced. The car is then ready to take the owner's family out for a pleasure trip.

The trailer may be fitted with any type of body, according to the class of goods to be carried and principally differs from the ordinary wagon in that it has rubber-tired wheels mounted on roller bearings. These enable the car and trailer to travel at speeds of twenty miles per hour or more and eliminate the trouble caused by the overheating of the plain iron bearings such as are used on slow-speed horse wagons.

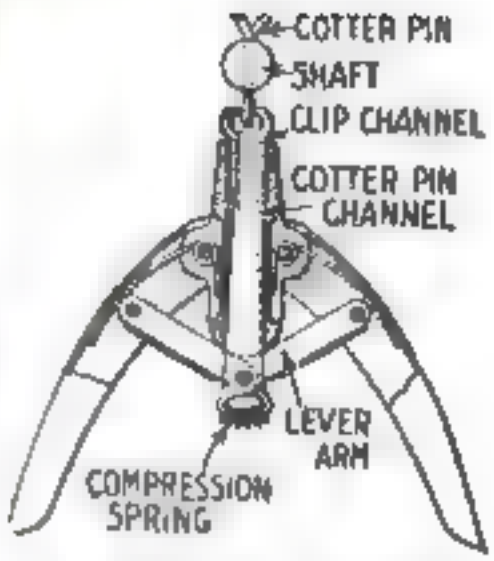
The jack device for lifting the front end of the trailer consists of a triangular-shaped framework made of pipe sections It is pivoted to the underside of the trailer and has a telescoping bar attached to the trailer axle to keep the framework upright when in use This eliminates the wooden horse formerly used and permits the trailer to be moved from place to place for loading and unloading.

Do It With Tools and Machines



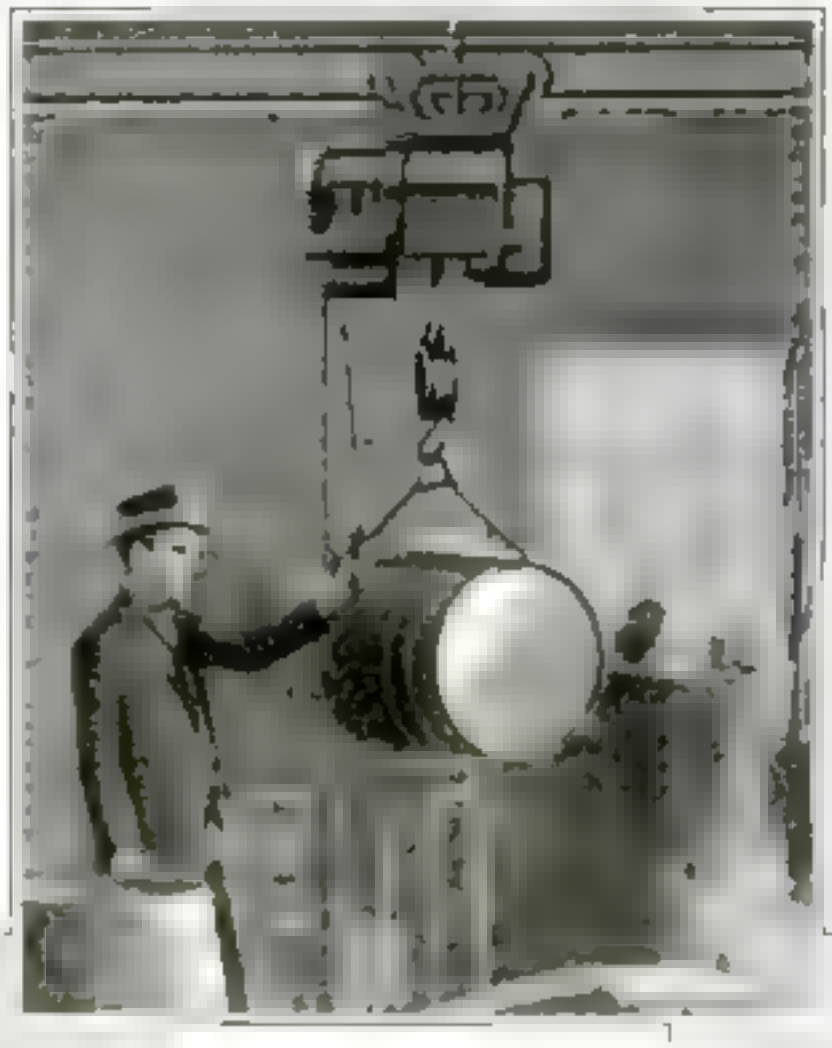
A convenient oil and grease cup in which the grease is retained for an emergency. The object of this cup is to prevent the overheating of the bearing should the oil passages become clogged or the attendant fail to start the oil cup feed or neglect to fill the oil cup promptly

With this electrically driven screw-extractor a broken screw may be removed as quickly as a new one without waste of time It is made similar to the portable electric drill



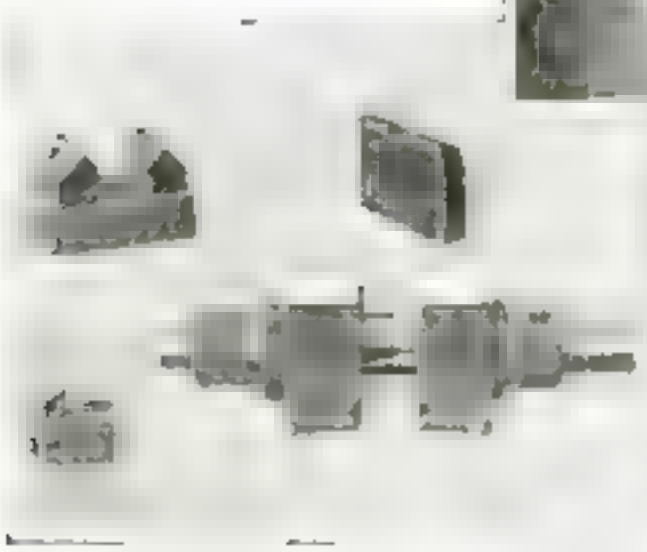
A cotter pin extractor that not only draws the pins but straightens the shanks so that they may be used again without any special operation to permit their reinsertion in the opening of the bolt or shaft from which they were taken. The clip for drawing the cotter is worked by a pair of arms between the closing handles

A triangle that can be used alone for drawing any kind of an angle or series of parallel lines directly and easily



A light inclosed electric hoist that may be operated from a distance and used in a manner similar to the hoisting unit on traveling jib or wall cranes. The addition of an operator's cab adapts this hoist for high speed intercommunication

A handle like a saw grip to receive the shank of an ordinary file of any size

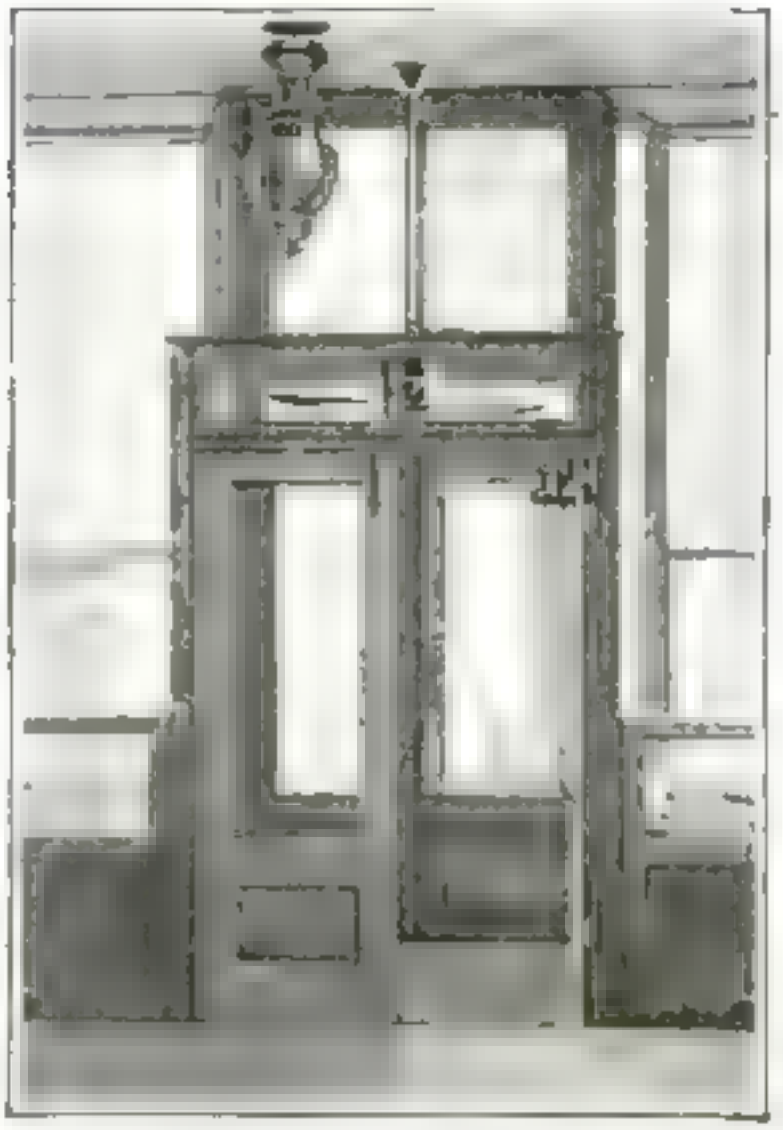


A vise for use between milling machine centers which saves much of the time of the usual set-up

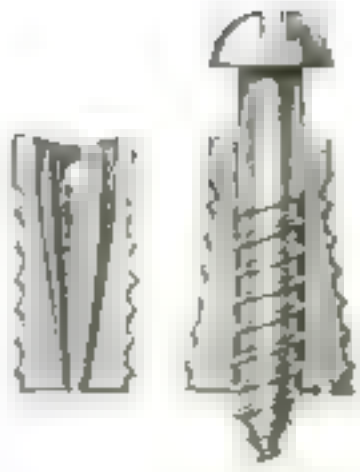
An expansion bolt shown in detail in Fig. 1 and fully expanded in hole in Fig. 2

Do It With Tools and Machines

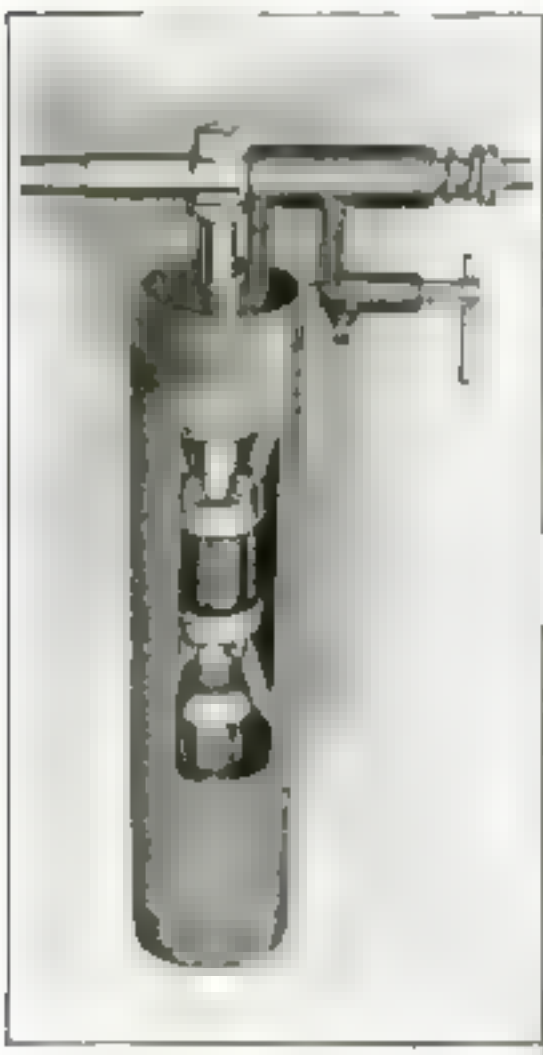
A hook made of strong wire with a snap having a tempered steel tongue at one end is very handy for holding a paint bucket or fruit pail on a ladder rung



An ordinary electric ceiling fan is kept running in this vestibule and when the outer door is opened the air is driven outward so swiftly that very few flies, if any, will be able to effect an entrance

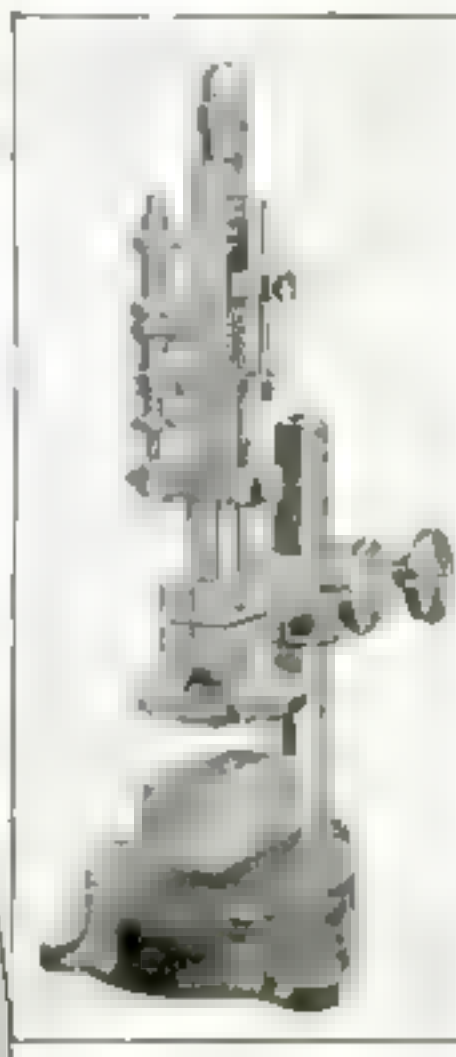


By changing the form of the interior bore of this anchor for a screw the maximum expansion is given where the greatest frictional contact occurs, which increases the holding capacity



The usual method of cutting the larger sizes of pipe on a lathe is improved upon by the use of the hand power threader illustrated above. It may be taken to the job

A portable electrically driven valve-grinder which gives the familiar oscillating motion. The speeds of the electric grinder are far greater than those attained by the hand method



A measuring gage using a fluid against a flexible diaphragm to obtain readings in ten thousandths of an inch or closer to determine the thickness of stock

Fighting in the Air

The new machines that have been evolved and the way they fight four miles above the ground

By Waldemar Kaempffert

(The following article is based upon facts which have been kindly supplied by Major W. L. B. Rees of the British Commission. Major Rees was sent to this country as a member of the British Commission to give to our army officers the benefit of the British experiences on the battlefield with flying machines. He is an officer of the Royal Flying Corps who has seen active service in the air and who, single handed, brought down ten German flyers.—Editor)

THE General Staff of every European army knew five years ago that the airplane would prove a potent factor in war. Germans, English, French, Italians, all had tried to evolve a system of air-scouting in their annual maneuvers. The Italian campaign against the Turks in Tripoli and the Balkan wars had proved clearly enough that a man in the air could see more than could a man on horseback.

And yet all the European generals entered this war without even a dim realization of the terrible demands that would be made of aircraft; of their utter dependence on a handful of dauntless men ready to vault into the air and brave not only the unseen whirlpools and maëlstroms of a turbulent atmosphere, but bursting shells hurled from the ground and the machine-gun fire of an adroit enemy air-fighter; of the inadequacy of the airplane as it was built before that fateful month of August, 1914, when all Europe was plunged into carnage; and of the frightful wastage of machines and lives. Even the Germans were unprepared.

New Types Had to Be Evolved for the Exigencies of Battle

Every army had machines—the French and Germans hundreds of them. But no one knew that airplanes would have to be built for very special military purposes; that the same machine could not be effectively used for scouting and fighting; that the acrobatic performances of Pégoud and his imitators in "looping-the-loop" and diving tail-first would be elevated to the dignity of military tactics with which every fighting airman would have to be familiar. In two years the whole art of airplane construction has been almost miraculously improved, and the art of flying, too. Before the war, some effort was made to adapt the machine to the man; now the man must adapt himself to the machine Where are the elaborate, automatic stabilizing devices with which all governments experimented before the war? Where are the machines advocated for their inherent stability? The machine of 1917 is only outwardly identical with the machine of 1913.

About six types of machines have been developed as the result of war experience:

1. There is the fighter—a 150-mile-an-hour, single seater, which is armed with a machine gun, which has limited fuel-carrying capacity, and which serves to find, fight and destroy the enemy.

2. There is the two-seated fighter. It carries a fixed machine-gun at the front and a machine gun on an "all-around" mounting for the observer in the rear It is not so fast as the single-seated fighter. It also finds and fights the enemy; but it also escorts patrols into the enemy country and protects machines engaged in fire-control. It has more fuel-carrying capacity than the single-seat fighter, because it must stay up longer.

3. The reconnaissance machine is armed like the two-seated fighter; but it is not so fast and does not climb so rapidly. For short distances over the line it is amply able to protect itself. If it goes far, however, it must be protected by two-seated and even single-seated fighters. It is equipped with a built-in stereoscopic camera. The pictures taken are studied by staff officers to note changes in enemy positions and to discover concealments.

4. The fire-control machine directs the batteries by means of wireless. A reconnaissance machine when fitted with wireless apparatus may be used for fire-control.

5. The bomb-dropper resembles the two-seated fighter, although bombs can be carried by various machines. Bomb-carriers, being weight-carriers, are large.

6. Night-flyers resemble either the reconnaissance machines or two-seated fighters.

All Europe Was Aëronautically Unprepared —Even the Germans

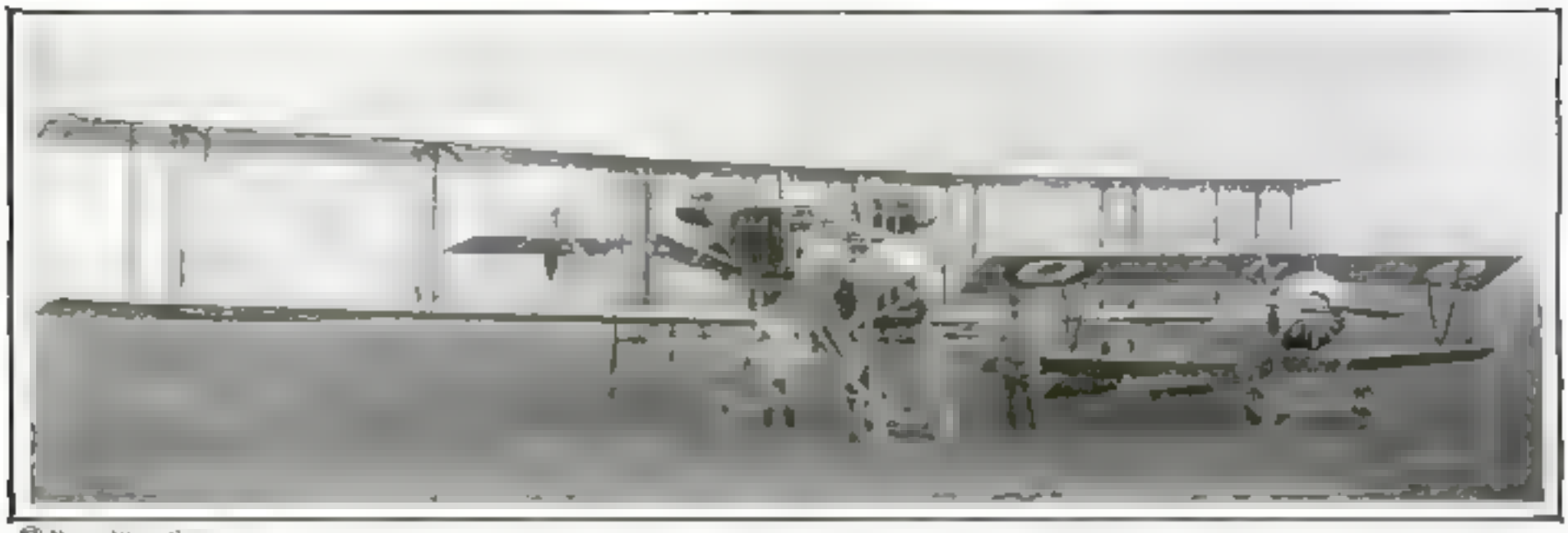
It was a very heterogenous collection of machines that took the air at the outbreak

Carrying the War into the Air

Captain Georges Guynemer, pictured below, is probably the most skilful air-fighter on the French side. Although he joined the aviation corps a mere boy, he has been rapidly promoted. He has a record of thirty-seven German machines to his credit. In the picture he is holding the battered, twisted remnant of a machine gun taken from a German battle plane that he brought down

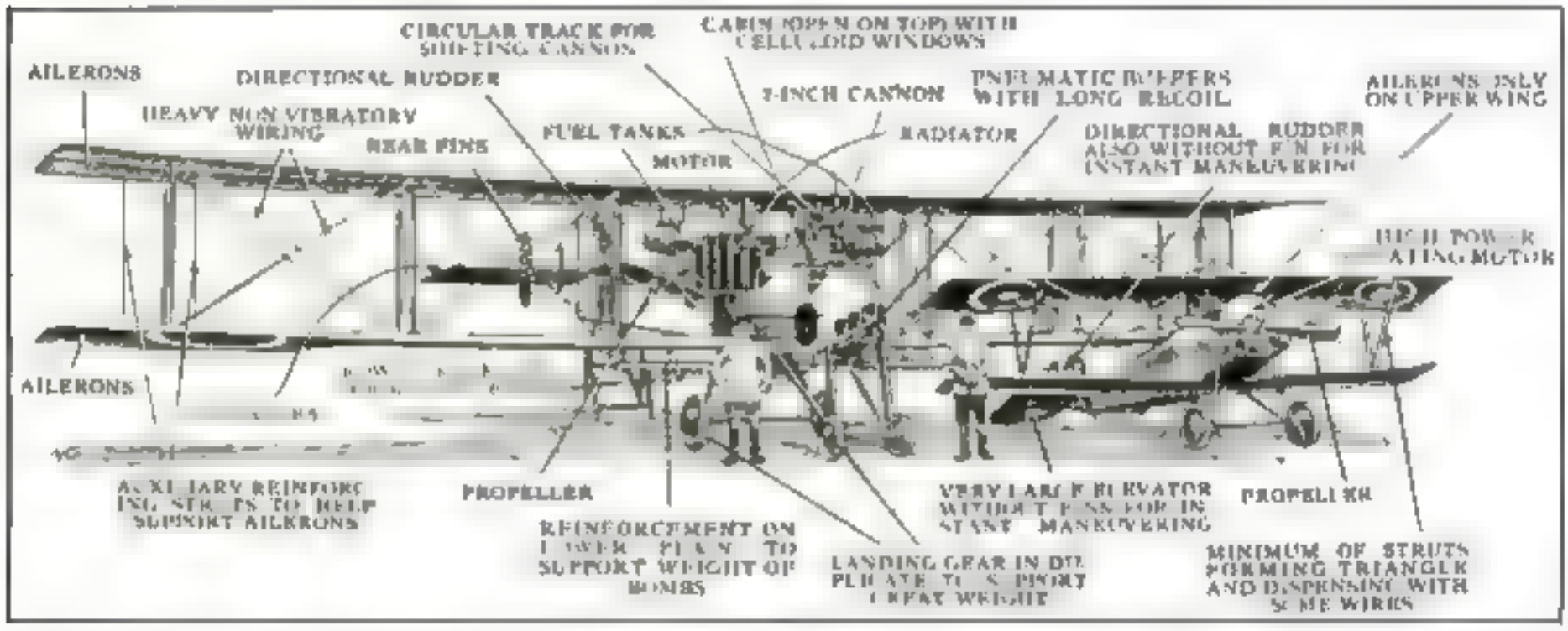
Captain Boelcke, pictured below, was by far the best air fighter that Germany produced. He was killed at the Somme in a collision with a member of his own air-squadron. Boelcke was such an important personal factor that, although he had been sent home to rest by the Emperor, he was recalled when the Germans found that they were losing in the air alarmingly at the Somme

The opposing squadrons watch and watch each other. Woe betide the man in a squadron who lags behind for a second, who manipulates his control a little too carelessly, who is not quite en rapport with his teammate in the machine beside him! Two enemies swoop down upon him. He is cut off from his fellows. He must fight for his life. Up and down, in and out he maneuvers, shooting when he can. But his enemies outnumber him. He has not a chance. There is a squirting of bullets. His machine drops a sickening sight—three miles to earth



© Press Illus. Serv

Two extremes in airplane types—the big bomb-carrier and the fast single-seated fighter See key diagram below



of the war—monoplanes with tractor propellers, biplanes with both tractor and pusher propellers, machines with and without streamline bodies, fast racers, and slow, cross-country flyers. One would suppose that the military brains of Europe would have foreseen that some effort would be made to beat off a prying airscout. That it was foreseen, the rather crude anti-aircraft artillery evolved before the war proves; but no one could foresee how combats at a height of ten and twenty thousand feet would be fought, or how a machine should be designed for effective fighting. Maneuvers in time of peace may teach much, but blank cartridges can never teach as much as cold lead.

First of all, it was discovered that for bombing raids, for reconnaissance and for fighting, different types of machines must be employed. Your bomb-carrier cannot be much faster than ninety miles an hour—slow as speeds go nowadays. Such craft must be protected by fast fighting machines during a long over-land flight to some hostile railway junction which is to be wiped off the map. Your scout and artillery-fire control machine must stay aloft for hours; it must carry much fuel; therefore, while it may be faster than a bomb-carrier, it cannot be designed for high speed. Slow machines must be protected from attack on overland journeys by fast fighters. And so the fighting machine was evolved—a marvelously swift machine, making as much as 130 miles an hour and as quick as a dragon-fly in darting and twisting about.

Reconnaissance, artillery-control machines, fighters—all are armed with machine guns. But only the fighters, single and double seated, are built specifically for combat. The others fight only when they must—in some situation of dire necessity.

How a Difficult Problem Was Solved

There was no fighting in the air during the Tripolitan and Balkan campaigns; but in this war there was air fighting almost from the beginning. At first rifles and pistols were used. They proved worthless. A machine-gun alone could be used effectively, something that would squirt death like water from a hose. But the use of a

machine-gun implied the building of an airplane able to mount and fire it. Now it was soon found that the pusher type of airplane, which carries its propeller in the rear, is not so fast as the tractor, which carries its propeller in the front. It was also found that for fighting, at least, quick-maneuvering ability is highly essential, which implies a small, high-powered machine carrying only one man. Here was a very difficult technical problem to be solved: The fighting machine had to be a tractor for speed; the propeller in front necessarily interfered with the proper manipulation of the machine-gun; the officer in the pilot's seat had not only to keep his machine on an even keel but also to fight his gun. Had the military strategists of Europe been told before the war that these were the conditions that would have to be fulfilled, they would have dismissed them as absurdities at once. But by the middle of 1916, the requisites were so clearly recognized that they were met, and that with astonishing ingenuity.

The Fast Fighting Machine Appears

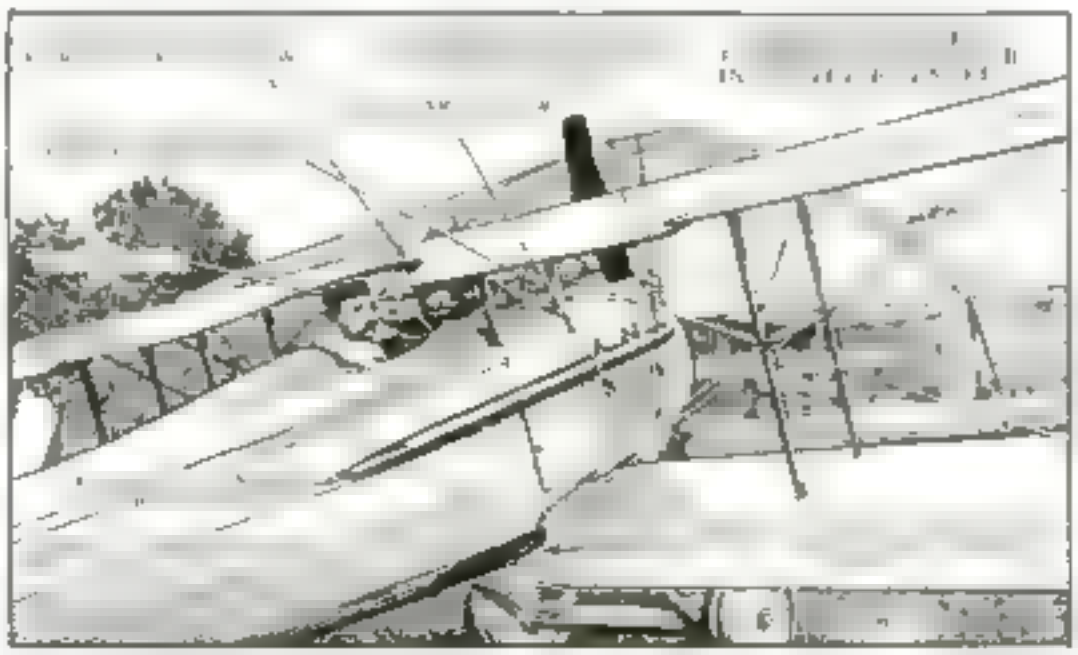
By the end of 1915 it had been discovered that of all the flying machines used by the Allies, the fast racing monoplane of Morane-Saulnier in France and the speedy biplane racers made by the two firms of Sopwith and Bristol in England were best adapted for air fighting, simply because they had speed and dragon-fly maneuvering ability. They were given more speed by equipping them with engines of one hundred and fifty horsepower and even more, and they were strengthened so that they might withstand the enormous stresses set up in flight by engines so powerful.

Curiously enough, the problem of firing through the propeller had been solved before the war by some imaginative inventor with more vision than is given to academically trained generals, and curiously enough it was solved in both France and Germany simultaneously. The solution was this: The gun was rigidly mounted in front of the pilot, and it was mechanically connected with the engine. A propeller revolves at about 1,200 revolutions a minute; a machine-gun fires at the rate of 600 shots a minute. Let the engine fire the gun at just that fraction of a second when no propeller blade intervenes—that is the solution.

Because the gun is rigidly mounted, the air fighter must turn the entire machine toward his German enemy to fire it. The enemy does the same; for the German Fokker, an adaptation of the French Morane-Saulnier, is similarly designed and equipped with a fixed machine-gun

© Central News Photo Service — See key diagram below

Fast fighting machines have engines of 150 horsepower and more, and are strengthened to withstand enormous stresses



When these fighters first appeared on the side of the Allies they drove everything before them. It was impossible for the slower Germans to cope with them Then the Fokker appeared. The machines of the Allies were made still faster, the fighters became more skilful, more daring; fighting tactics were evolved. As a result, the Allies have not only caught up with each German improvement but have surpassed it.

It is rarely that German machines—fighters or scouts—appear over the French and British lines; but the machines of the Allies are always over the German lines. That meant much at Arras.

When these fast fighters first made their appearance there were some single-handed combats. A German and British charioteer of the air would wheel about, jockeying for a position in which, for a few fleeting seconds, either might pour in a hundred bullets at his enemy. It was a favorite maneuver of the German flyer to rise very high, to plunge down on an adversary, and to fire as he came. But Boelcke and Immelmann were about the only flyers on the German side who were either skilful or daring enough to engage in frequent single-handed combats. As a rule, the Germans attacked a single British or French machine in twos and threes. The procedure may be attributed in part to the different temperaments of Germans and British and in part to military policy.

Like Flocks of Birds the Squadrons Maneuver

The result has been that fighting in the air is now undertaken, as a rule, only by squadrons. Six machines, sometimes more, constitute an aerial tactical unit. Their pilot-officers live together, sleep together, eat together. They know one another better than if they were brothers. Every mental and emotional characteristic is bared. So it happens that in the air, when the six machines are flying side by side in twos, the men know instinctively what they are to do. Have you not seen flocks of birds on the wing, circling about with a unanimity of understanding that makes it seem as if they were obeying a command? It is so with the air fighters of a squadron. They move as one, like a flock of birds, with never a word of instruction.

An engagement between opposing squadrons in the air is not like a battle at sea—a fight between fleets. Around and around each other the planes whirr, each team following the leaders with clock-like precision and automaticity.

The opposing squadrons watch and watch each other. Woe betide the man who lags behind for a second, who manipulates his controls a little too carelessly; who is not quite *en rapport* with the team-mate in the machine beside him! Two machines of the enemy swoop down. He is cut off from his fellows, like a bird from its flock. He must fight now for his life. Up and down, in and out, he maneuvers with his foes. He shoots when he can—when a hostile machine is directly in front of him. But his enemies outnumber him. He cannot outmaneuver two machines. One, at least, must sooner or later swing around into a favorable position. Then there is a squirting of bullets. The machine drops, a mass of flame, three miles to the earth—a sickening sight even to those who have been steeled to the horrors of the most horrible of wars. A charred, twisted mass of metal and wood is picked up. Within it is a scorched, torn uniform containing an unrecognizable, mutilated mass, all that remains of a brave man who was not quite quick enough, or whose mechanism failed him for a fatal fraction of a second.

How the Airplanes Carry War Into the Atmosphere

Whenever that terrible artillery preparation takes place of which we read in the newspapers (the deadly hail of tons and tons of metal that precedes an attack with the bayonet) the fighting squadrons are high in the air—twenty thousand feet above the ground. Below them, at perhaps ten thousand feet, are the two-seated fighters and reconnaissance machines each patrolling a section of the enemy's line, taking hundreds of photographs. And below, at six thousand feet, are the machines that control the artillery fire—machines that watch each shot as it falls and that wireless back the signal "too short" or "too long." Without the reconnaissance officers the scouts and the fire-controllers could not perform their task; they would be attacked and annihilated by fast airplanes mounting machine-guns. To be sure, they are armed themselves so that they can keep up a running fight. But on the daring, fighting squadrons far, far above the battle line, on them depends the fate of an army; on them depends the possibility of gathering the facts that the heavy artillery in the rear must have to fire at a mark ten miles distant

To the all-seeing eye in the air, nothing is concealed. It is that eye which has made it utterly impossible for either side to execute a flanking movement that would envelop a whole army and compel a surrender, that eye which has made it necessary for armies to burrow in the ground and face each other in a nerve-racking, soul-trying struggle.

A garden in which nothing but weeds can find a place. It is the one spot in all the world, perhaps, where weeding means cultivation of weeds. Later on, various exterminators will be tried on them

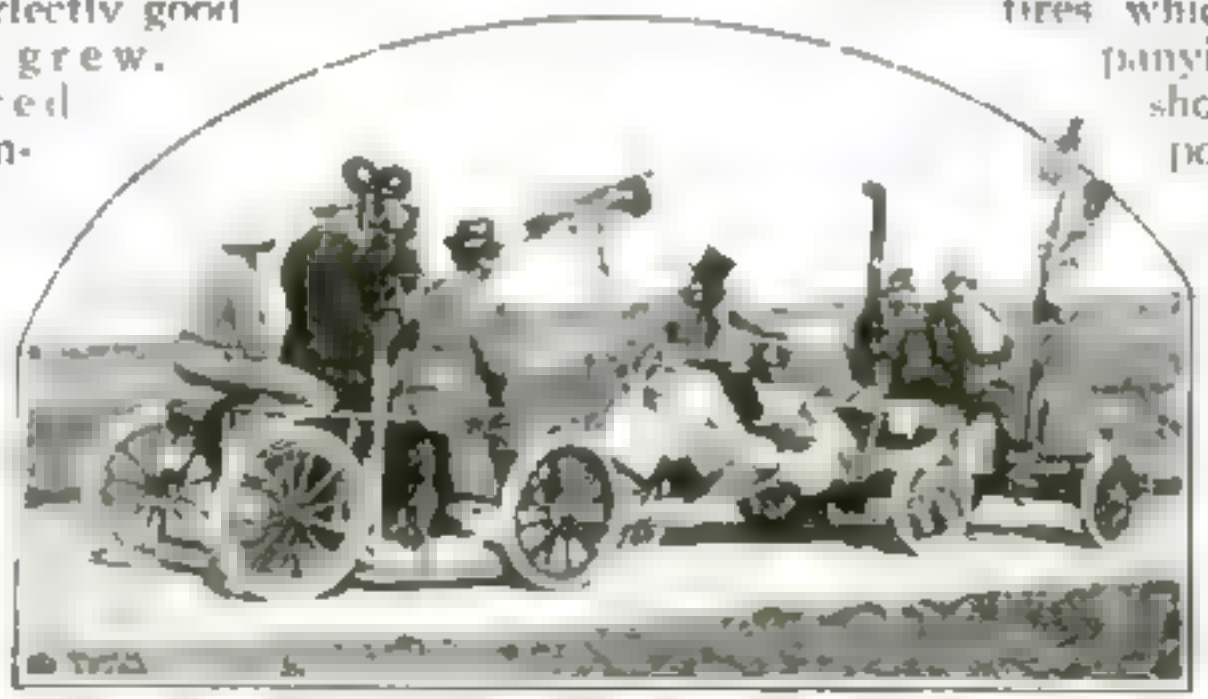
A Garden in Which Weeds Are Not Only Tolerated but Cultivated

"FOR every evil under the sun there is a remedy or there is none," says the jingling rhymster, and leaves it to the scientist to find out whether there is or not. To find the remedy for weeds, the bugbear of every farmer and lover of growing things, a garden was planted at the Agricultural Experiment Station of the University of Minnesota and 175 different varieties of the pests were given honorable lodgment in the perfectly good soil. They grew. They thrived. They bore abundant seed. They were classified and a collection of weed seeds was produced and listed. Then repellents and exterminators were tried out on them.

Taking Motion Pictures on the Road in a Queer Vehicle

THE motion picture director is a creature of weird fancies. If he were otherwise he would not be a motion picture director. He lies awake nights worrying about ways for doing something different. If he becomes hum-drum, if his ideas smack of the commonplace, his directorship is soon ended.

The quest for novelty partly explains the freakish caravan on rubber tires which the accompanying photograph shows. The purpose of the queer equipage is serious. It is seeking the right landscape for a background for a special comedy, and is transporting the camera and troop to the spot.

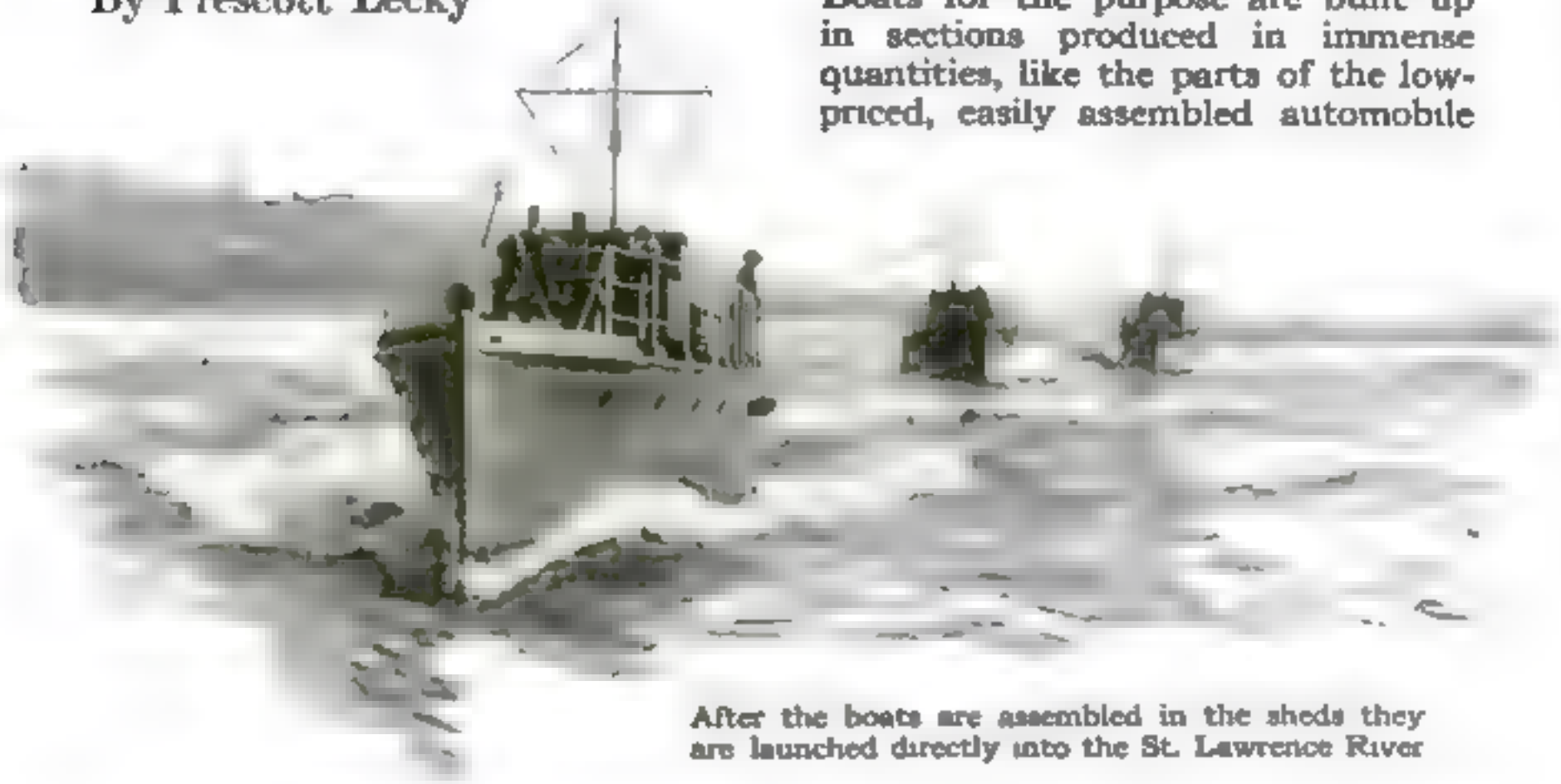


Film comedy has its queer moments, such as traveling in freak equipages and make-up in search of suitable landscape

Chasing Submarines with Motor-Boats

By Prescott Lecky

Boats for the purpose are built up in sections produced in immense quantities, like the parts of the low-priced, easily assembled automobile



After the boats are assembled in the sheds they are launched directly into the St. Lawrence River

WHEN England found the submarine was a menace that threatened to destroy her paramount position as a maritime power and a maritime nation she cast about her for a means of combating the underwater terror. One of her purchasing agents visited the New York office of Henry R. Sutphen, an official of a boat-building company and a submarine company.

"Why don't you try motor-boats?" suggested Mr. Sutphen, and proceeded to outline the sort of craft he had in mind. The conversation resulted in a provisional order for fifty boats, given subject to the approval of the British Admiralty. Not only was this order confirmed, but a short time afterwards it was increased to five hundred and fifty.

The boat called for was to be 80 ft. long, 12½ ft. beam, 4½ ft. draft and of 32 tons displacement. Two standard motors of 220 horsepower were to drive her at a speed of fourteen knots for 850 nautical miles or nineteen knots for a distance of 700 nautical miles. The fuel capacity was to be 2100 gallons, and the gasoline was to be consumed at the rate of one pint per horsepower per hour. She was to carry a crew of ten men, including gunners to operate the 3-inch rifle mounted forward.

Applying Automobile Manufacturing Methods

Naturally it would have been impossible to construct so many boats of such a large size in so short a time by the usual methods. The methods of the automobile factory were adapted to the shipyard. First, "the master boat" was built and every part that went into its construction was carefully measured and recorded on templates or wooden patterns. The templates were then sent to the shops and five hundred duplicate pieces ordered. Every one of these pieces was lettered and numbered on its arrival at the plant. Three machine shops were kept busy turning out the motors. Most of the woodwork was done in Bayonne, N. J. More than eight and a half million feet of finished lumber, sawed and dressed to the required sizes, was turned out by this shop.

When arrangements had been made for the material, new yards on the St. Lawrence River in Canada were about completed. The plant consisted merely of half a dozen huge assembling sheds, and it was here that most of the ships were made.

As the keels arrived they were put in their places along the floor, and the delivery of the various ribs, beams and parts was so timed that no storage space was necessary. Every effort was made to simplify operations and to avoid handling and carting the material more than once. For instance, as soon as the engine, anchors and chains arrived they were distributed immediately, an anchor being laid in front of each keel.

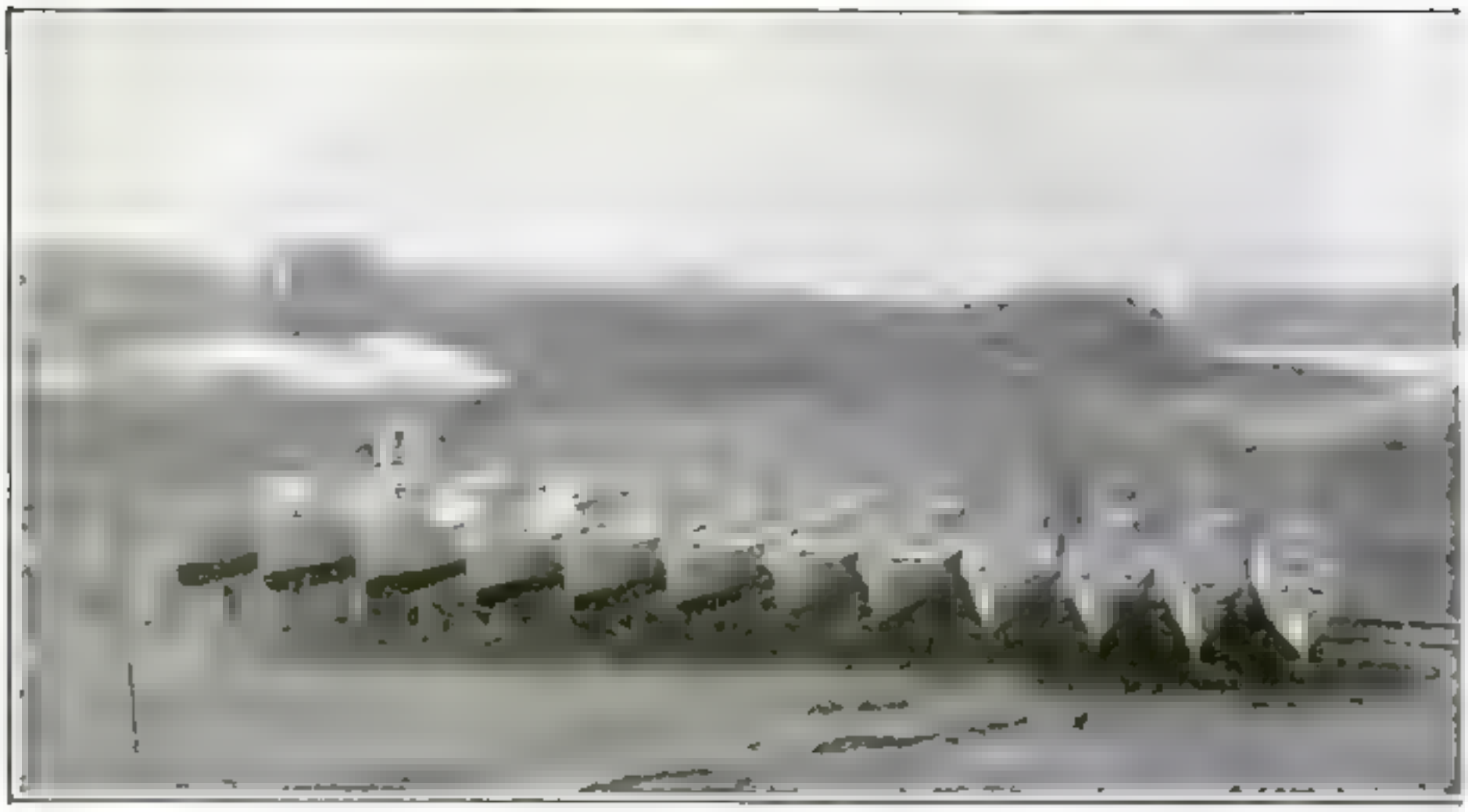
All told about fifty separate operations were necessary in putting these parts together; for each task there was a separate gang of workmen who did nothing else. It was not advisable to build a permanent plant of this size equipped with cables and roof pulleys. Hence progressive assembling in the automobile sense could not be applied. Automobile-assembling practice was reversed. The boats remained stationary while the men moved along. Otherwise there was no essential difference. So rapidly were the boats completed by this method that the sheds were soon crowded, and extra keels were laid outside. Some of the boats were launched directly from the shed while others were placed on railroad trucks and carried to the ways. Every vessel was thoroughly tested by British Naval inspectors before it was accepted. The boats were shipped to England on the decks of ocean steamers, four chasers being carried on one liner.

Since the war began, the production has increased from three boats a year to three a day. Five hundred and fifty submarine chasers, eighty feet in length, were completed in less than five hundred and fifty days from the time the contract was signed. Perhaps the most surprised witness of this accomplishment was the British Admiralty itself. And England, as everyone knows, is the greatest maritime nation of the world.

Some of the chasers were launched from the shed but others were made inshore and had to be brought to the ways by rail

An idea of the tremendous amount of detail that had to be looked after in this undertaking may be gained from the following brief list of figures: 550 gas stoves, 2,200 fire extinguishers, 2,200 sailing lights, 550 life boats, 550 searchlights, 25,000 incandescent lamps, 974,504 bolts and nuts, 3,850 oil lamps, 13,200 canvas covers, 22,000 storage batteries, 109,450 ft. of brass pipe, 611,000 ft. of manila rope, 33,200 running yards of deck canvas, 16,500 port lights, 1,650 sinks

When the sheds in which the boats were assembled were filled, additional keels were set up outside. Here some of the boats are shown in an advanced stage, almost ready for launching



Picture continued on next page

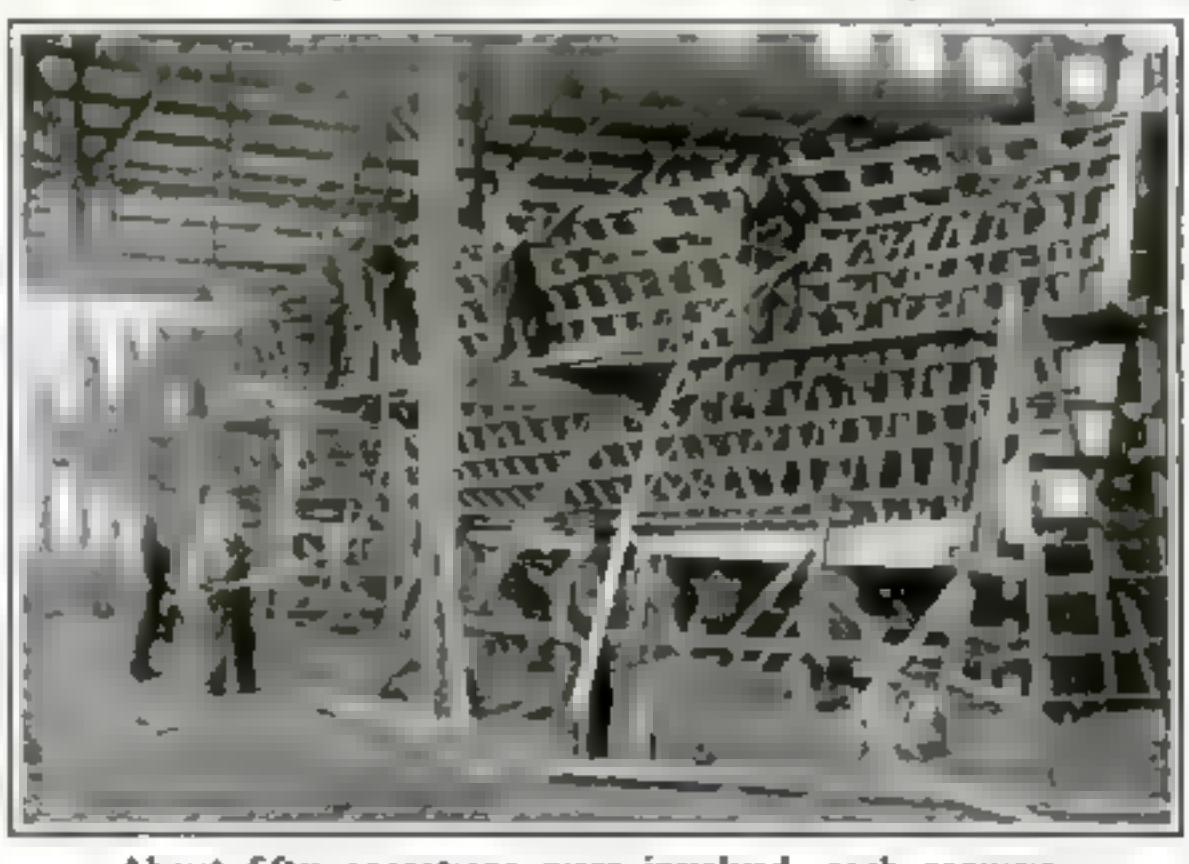
Some of the finished boats ready for inspection Each boat was thoroughly tested in the St. Lawrence River before being accepted. Arranged as in the photograph the five hundred and fifty boats

and wash basins, 11,550 ventilator cowls, 1,650 toilets, 325,000 ft. of wire rope of various kinds and 450,000 pounds of paint, varnish and putty.

Will Every Coast Dweller Own a Motor-Boat?

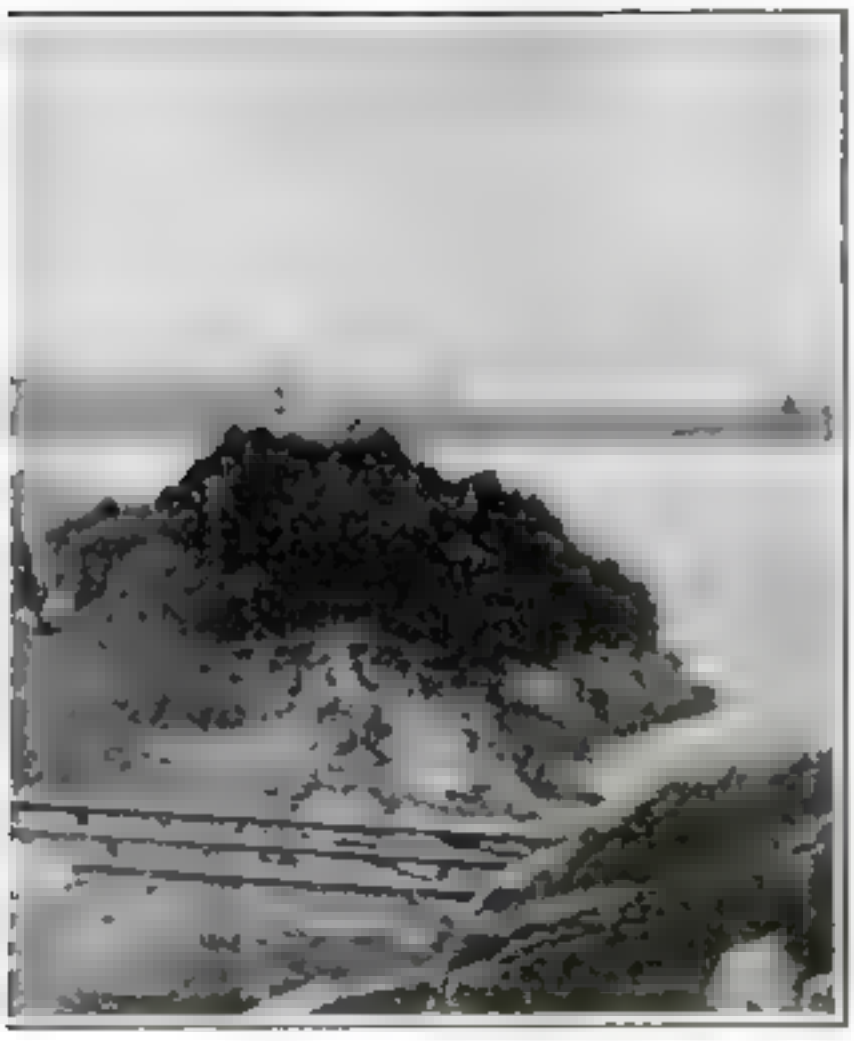
In the assembling operation alone more than 3,000 men were employed, and about 9,000 others were scattered in the various workshops fabricating the material before it was sent to the main plant. This is the first time that the principles of standardization, division of labor, and progressive assembling have ever been applied with any thoroughness to shipbuilding. There is no reason, however, as this successful experiment proves, why motor-boats cannot be turned out cheaply enough to make them as available to the average citizen as is the popular-priced car.

The movement toward standardization began in 1905, when Mr. Sutphen's company built 120 twenty-one-foot mine-yawls for the United States War Department. The same company two years later built 33 thirty-foot mine layers on standard lines, and during the next six years turned out 110 thirty-six foot power life boats for the United States life-saving service. Probably the largest motor-boats ever built according to uniform design were two 98-foot yachts, made in 1910. Others who have made experiments along the same line are company that turned out a number of thirty-footers, and another that has been building twenty-foot steel motor-boats in fairly large quantities on standard patterns.



About fifty operations were involved, each requiring a separate gang of men. Here is the "ribbing gang"

It should not be imagined that these submarine chasers built



covered eight miles. End to end they would form a chain nearly twenty-five miles long

for England were motor-boats in the ordinary sense. They were really yachts. The interior design from bow to stern was as follows:

Chain locker, lavatory for crew, forecastle for eight men, ammunition room, large fuel tanks, engine room, galley, mess room, office state room for two and additional tank capacity in the extreme rear. On deck there was a platform forward for a three-inch gun. Behind this was the chart house, and further back still the bridge where the steering apparatus and engine telegraph were located.

One feature of this boat is an arrangement by which the steering lines are laid along the side of the deck from the wheel, making them easily accessible for repairs.

The chasers were designed for service in the English Channel and the North Sea, and while their sea-keeping qualities are excellent, nevertheless they do not carry enough food and fuel to last more than ten days. On the other hand, however, a boat of this size painted gray is invisible at a distance of more than three miles, so that it is often possible to catch the submersible unawares. The boats are intended for offensive operations almost entirely, though of course they would make good convoys near the coast.

The British have discovered that fighting the submarines is a question first of all of endurance. A larger chaser would be more comfortable, of course, but by no means so dangerous to the submarine.

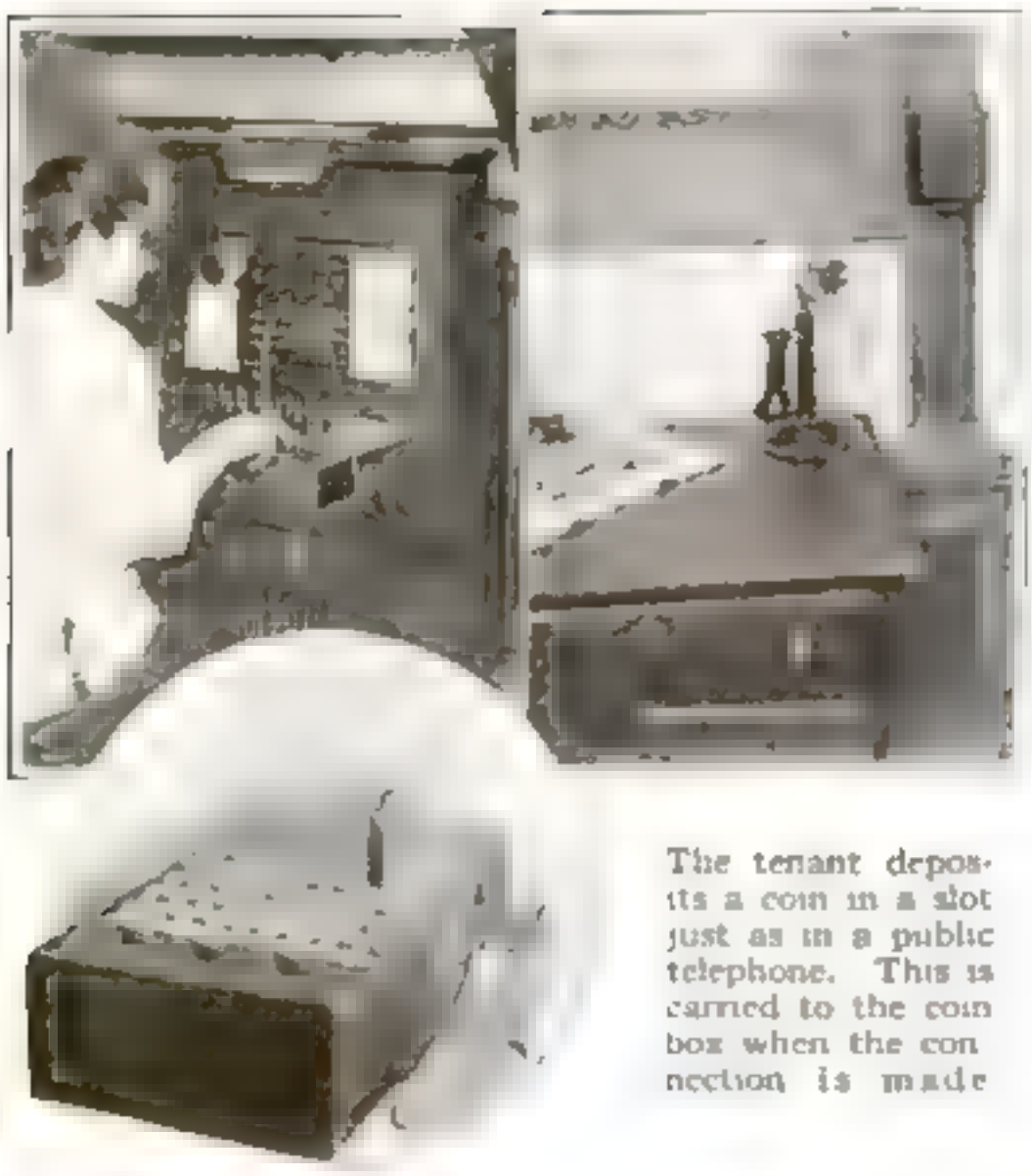
A Board Which Will Help You Learn to Swim

A SWIMMING board invented by William H. Roberts, of Newburyport, Massachusetts, is a help in learning how to swim.

The device is nothing more than two warp-proof boards of pine which are fastened together at a very large angle. The swimmer straddles these at the narrow junction of the boards. Lying with his body flat upon the front board and resting more or less upon the saddle board, he is buoyed up in the natural position for swimming. He learns the leg strokes first and then the arm strokes, and he rests back upon the boards whenever he becomes tired. By keeping his legs going slightly, the board is kept from overturning.

The buoyancy of the boards helps him to ride the waves and contributes to his enjoyment. Since there is no danger to fear, confidence is soon gained and the swimming strokes are mastered in short order. The swimming board is used purely for sport, also.

The buoyancy of the boards prevents you from sinking below shoulder level



The tenant deposits a coin in a slot just as in a public telephone. This is carried to the coin box when the connection is made

Changing the Apartment Telephone into a Pay-When-You-Call System

A NEW telephone device deserves a Carnegie medal for furthering the cause of universal peace between tenants and apartment house managers. It enables the manager to collect at the time of the calling, and protects him and the tenant as well from being overcharged.

The coin-collecting device works entirely independently of the regular telephone system. Thus, the tenant calls the operator's switchboard in the apartment house lobby and is connected with central just as usual. But before the operator actually connects the tenant with central, she connects the coin-collecting box in the tenant's apartment with a recording box on her switchboard prefacing the action with a request for "Five cents, please." The recording box signals her the instant the nickel is placed in the collecting box. If central obtains the person called, the operator then connects him with the tenant, and by pressing a button, deposits the nickel in the coin box. If the person called cannot be found, the operator then presses another button to return the money to the caller, just as in other pay-telephone systems.

This accessory has a credit feature, however, which is unusual. In case the tenant is out of change, the operator releases a brass check of the size of a nickel from the coin box. The tenant uses this, and when the manager comes around to collect the coins deposited, the tenant redeems these from him.

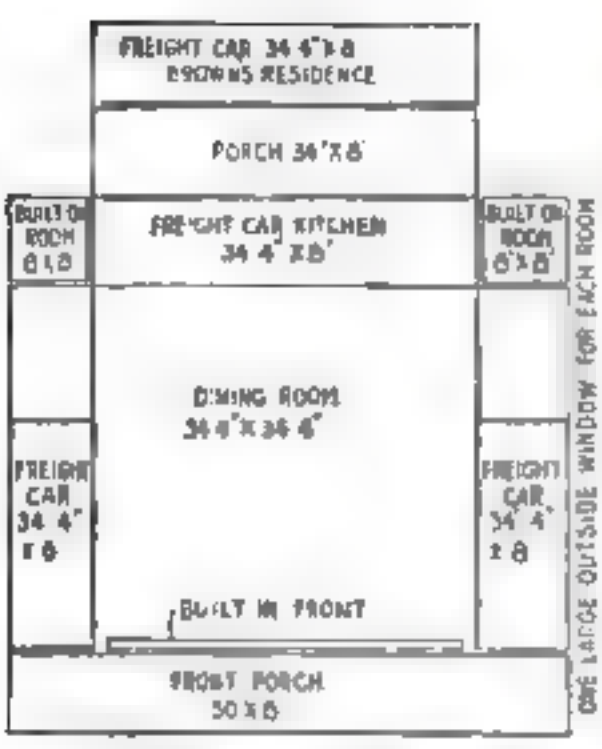
Be Thou Wary of the Bubbling Cup

A PROFESSOR in a western university has discovered that small organisms lodge in a great many kinds of bubbling-cup drinking fountains, and for a curious reason based on an ancient physical principle.

Twenty-five years ago writers of textbooks on physics had not the wealth of material to draw from that is now available. In carrying out one of their few experiments a rubber-tube-and-spout arrangement was prepared in such a way that it could be attached to an ordinary water faucet and a small jet of water was projected directly upward. In this jet a small ball would be placed—and, curiously enough, would remain in the air, almost stationary, held up by the jet. The jet seemed to clutch the ball and hang onto it instead of throwing it away. The stream would divide under the ball, come up equally on all sides and hold it in place. The sphere might oscillate up and down slightly, but otherwise it appeared to be settled permanently in place

The principle in accordance with which the ball is held up in the jet of water is the same as that of the germs held in the bubbling fountain

The western professor mentioned has discovered that bacilli may oscillate up and down in some kinds of bubbling cups all day long, day after day—in the same way and for the same reason that the sphere did in the old-time jet.



Plan and finished appearance of the box-car hotel. There are eight guest rooms and the landlord's apartment, besides hotel kitchen and storeroom. The two-story effect is only simulated

Owens Valley, California, Has a Freight-Car Hotel

OWENYO is a railroad junction point in Owens Valley, California, east of the Sierra Nevada Mountains. Mining and agricultural development have made it important. But it had no hotel. George Brown built one with the best material that he could find. He couldn't get steel for a frame or onyx for a foyer, but he could get box cars. So he built his hotel of box cars.

Standard box cars are thirty-four feet four inches long, eight feet wide and eight high. Three of these, unwheeled and with proper foundation, were placed in the form of a hollow square, inner corners connecting, with the open space facing the tracks. In this opening a front was built, with double doors and large windows. The center is a dining-room thirty-four feet four inches square, well floored, and lighted by many windows in a superstructure which gives the appearance of a second story. Across the front is a fifty-foot porch eight feet wide and across the rear another. Behind that is a fourth car, constituting the residence of the landlord and his family.

Each of the side cars is divided into three comfortable bedrooms, and at the rear, on either side, another guest room is built in, making eight guest rooms in all. The rear car in the building is the kitchen.

The entire building is metal-roofed, plaster-board finished and paneled throughout the interior. Every room has a large window.

Turn on the Water in Your Bath. It Can't Overflow. This Alarm Will Warn You in Time

WILLIAM J. ABERLE, of St. Paul, Minnesota, has devised an alarm which tells you when your bathtub has been filled to whatever depth you desire. Instead of having to watch the rising water, you simply adjust the alarm and let it do the rest.

A float on the rising water lifts a lever which operates the alarm mechanism

A light hollow float is suspended in the water by a vertical iron rod. The rising water raises the float nearer and nearer to a horizontal lever connected with a bell. When the rod rises high enough its upper end touches the bell trigger.

A spring is immediately released by the trigger, a clapper is brought into action and the bell rings. By adjusting the height of the bell mechanism, the height to which the water must rise to sound the alarm can be regulated as desired.

A Ten-Ton Motor-Truck on Eight Wheels

It combines the greatest possible carrying capacity with the high speed and easy riding of lighter trucks

The eight-wheel truck is mounted on two sets of four wheels each, with tires of the pneumatic type. This arrangement provides an easy-riding vehicle of great stability and carrying capacity

THE novel motor vehicle shown in the accompanying illustrations is mounted on two trucks, patterned after the old-fashioned four-wheeled railway coach truck, having eight supporting wheels in all. Each wheel helps to drive the vehicle, which is thus always able to secure traction, since it is extremely unlikely that all eight wheels would be mired at once.

Because of the large number of supporting wheels, the tires may be of the pneumatic type, even for as large a vehicle as a ten-tonner. The use of such tires instead of the solid-rubber type, which must now be fitted on the conventional ten-ton vehicle, would cushion the driving mechanism to such a great extent that the vehicle could be run with safety at greatly increased speeds. This is in line with the most advanced trend in vehicular transportation, which is to carry as large unit loads as possible at the greatest speed compatible with safety. Large loads on one vehicle take the place of smaller loads on a larger number of vehicles of less capacity. This substitution means less traffic congestion, which is one of the greatest problems the police forces of our most important cities have to contend with.

Aside from the advantages of carrying large loads at fast rates of speeds on pneumatic tires and of being able to secure the necessary driving traction at all times, even on bad roads, the eight-wheel arrangement also provides an extremely easy-riding vehicle of great stability and one of extremely short turning radius, since in the case of the vehicle shown, all the wheels are mounted so as to turn for steering.

In detail, the vehicle is mounted on two sets of four wheels, each set carried on a suitable cross-frame member. Each cross member has two arms on each end. Each end is made into the shape of a yoke to carry a wheel on a vertical spindle. This spindle simply serves to support the wheel so that it carries its share of the vehicle load and so that it can be turned in steering.

The power for revolving the wheels is secured from a conventional gasoline motor placed off the center line of the vehicle to the right at the front. The motor shaft extends aft of the crankcase in the usual manner and transmits its power to a four-speed gearbox located between the front

and rear sets of wheels by means of a short driveshaft. The power is in turn transmitted through the gearbox by means of a silent chain drive to two shafts, one extending forward from the front of the gearbox and the other aft from the rear side. Each of these shafts carries two worm gears, these meshing with large worm wheels and differentials mounted on supplementary axles which simply drive each pair of opposite wheels, but do not support any of the wheel load. Each of the supplementary driving axles is divided into two parts on each side, these parts being joined by means of universal joints so as to permit relative motion between any of the wheels of each truck, as when passing over road obstructions, without binding any of the driving members.

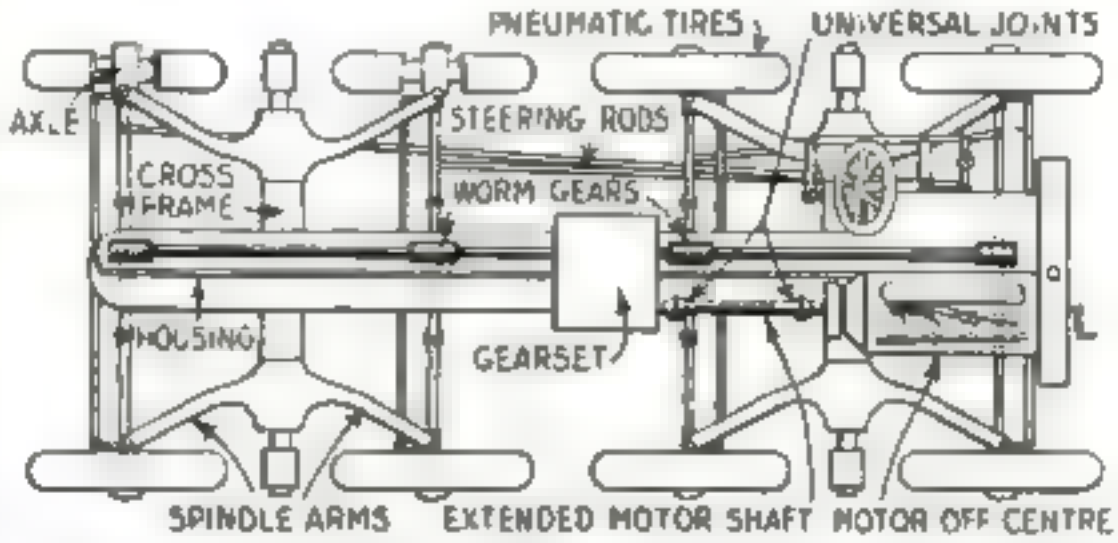


Diagram showing the driving and steering arrangement of the eight-wheel truck. All wheels turn for steering

The motor must be placed rather high so as to clear the front axle of the front truck. The top of the motor extends up into the driver's cab and is covered by a removable metal hood. The driver sits on one side of the motor and the helper on the other. This construction permits the driver's seat to be placed well forward, which in turn allows a longer body on the same length of chassis than would be the case in the usual construction with the motor under a hood out in front.

All of the wheels are arranged to turn for steering, this being accomplished through one steering wheel and column by attaching the steering crank by means of a rod to a vertical turn-bolt carrying three arms. One of these arms is a separate lever, while the other two really comprise one bar pivoted at the center. The separate lever serves to turn the vertical turn-bolt as the driver turns his hand-wheel to steer. Additional rods attached to one end of the two-armed bar lead to the front set of wheels, and other rods attached to the opposite end lead to each opposite pair of the rear wheels. Thus as the turn-bolt is revolved, causing the two-armed bar to revolve about its pivot, it makes the front truck wheels turn in one direction and the rear wheels, controlled from the opposite end, in the reverse direction, thus giving a very short turning radius.

To Make Your Lawn Attractive You Must Edge It Evenly

AN improvement on the ordinary lawn edger has been invented by Christian L. Schneider, of Davenport, Ia. It not only edges the lawn neatly but cuts a trough at the same time at a regulated depth.

The edger consists of a J-shaped knife carried on an arm which adjusts it to any height. One of the wheels of the edger runs on the path surrounding the lawn, with its outer flange pressed against the asphalt so as to insure a straight line. The other wheel is arranged so that it will keep parallel with the wheel on the path, whatever irregularities may occur in the lawn over which it travels. This makes it easy to push and insures a straight edge.

The outer wheel presses against the edge of the path to insure a straight line. A trough is dug at the same time

An Adjustable Rake for the "Land Patriots"

ALL contributions to the cause of agricultural preparedness will be gratefully received! Especially when they are as good as the adjustable garden rake that is shown in the accompanying illustrations. Instead of having to use a number of different sized rakes to fit between rows of different kinds of vegetables, you can adjust this one rake to suit all purposes. All the teeth of the rake, excepting the central one, are riveted to two rectangular side-frames pivoted to an iron socket on the end of the rake handle. When weeding,

When the central tooth is removed the rake will straddle the small shoots. Then both sides of the row can be worked at one time

Above: The side teeth adjusted to a narrow row. At right: The rake opened out

or when loosening the ground between rows of potatoes, for instance, the side bars are swung around until they aline. The rake, thus opened to its fullest width, is then locked in this position by the wing nuts shown. When cultivating onions, on the other hand, the angle between the side bars can be reduced to adjust the rake to the smaller width.

When the sprouts are young, this rake can be used for cultivating both sides of the row at one time. The central tooth may be unscrewed and taken out making it possible for the rake to operate on both sides of the small shoots.

Eliminating the Noise from Railroad Traveling

ONE railroad at least has solved the noise problem. Much to the delight of the passengers, the "Burlington Route" has rooted out the grinding of wheels, the creaking of axles, and the other noises usually attendant upon traveling. They have accomplished this by installing a soundproof flooring in their new steel cars. A layer of hair felt one inch thick, a layer of specially prepared paper, and a half-inch air space separate the steel floor of the car from the steel sub-floor nearer the ground. The sounds coming from the wheels are practically all absorbed by the insulating layers. Especially in traversing the loosely packed felt, the sound vibrations are readily lost in the loosely connected fibers, so that they will never reach the ears of the travelers.

Combining a Strainer with the Bung of a Barrel

A BARREL attachment which serves as a bung and a strainer in one has been devised by William R. Brison, of Tompkinsville, New York. Screw the attachment into the barrel and contents can be drawn through an exceptionally fine strainer, without retarding the flow.

The attachment consists of a hollow steel head that supports the cheese-cloth covered wire framework of the strainer.

The cheese cloth strainer extends back into the barrel like a long, hollow tube

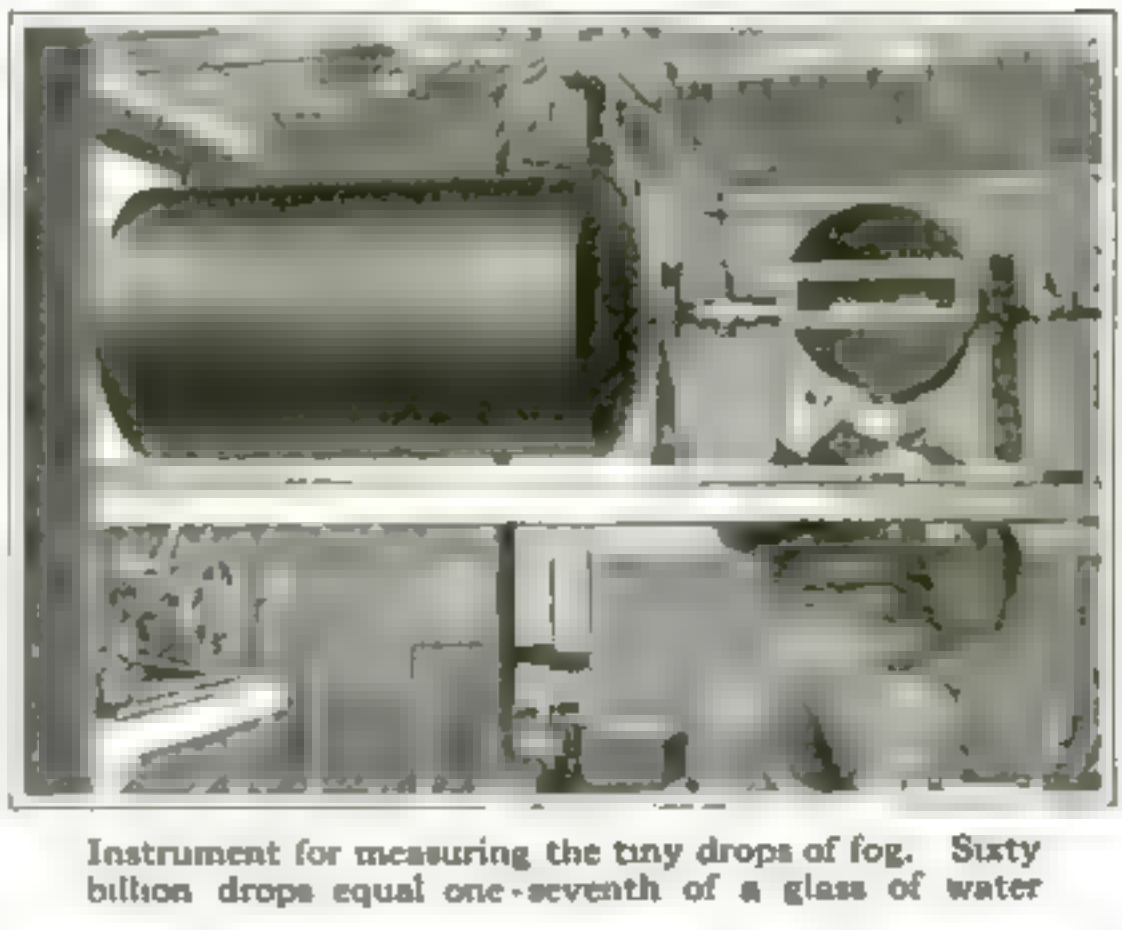
Counting the Moisture Drops in a Fog

MEASUREMENTS of fog have hitherto been crude But an example of more refined measurements of fog has recently been afforded by experts of the United States Bureau of Standards. The measurements were made in the most notoriously foggy region of the world—the Grand Banks of Newfoundland.

The tiny drops that constitute a fog are smaller than raindrops. They are formed by the condensation of the gaseous water in the air, known as water vapor. Each drop condenses about a "nucleus" —consisting of some substance other than water. The air always contains an immense number of these nuclei, ready to form centers of condensation, when the conditions of temperature and moisture are right for this process. A method of counting these invisible nuclei was devised by John Aitken. It consists in causing a drop to form around each nucleus in a sample of air, and then counting the drops through a microscope.

Another process, devised by Carl Barus, makes it possible to determine the size of the drops. When a light is viewed through a cloud or fog it is seen to be surrounded by a colored ring, called a "corona." You have seen such rings around the moon and around street lamps at night. The angular diameter, or aperture, of these rings depends upon the size of the drops. Small drops produce big rings, and *vice versa*.

The apparatus of Barus was installed in the pilot-house of the *Seneca*, and the number of nuclei present in a given volume of air was measured three times a day, whether the weather was foggy or otherwise. A sample of air was drawn through a pipe, projecting from the port bow. It was admitted to a "fog chamber," saturated with water vapor, suddenly expanded, to condense water on the nuclei, forming an artificial fog. The corona around a source of light, viewed through this fog, was measured, and the size of the drops was determined from the known amount of moisture in the chamber.

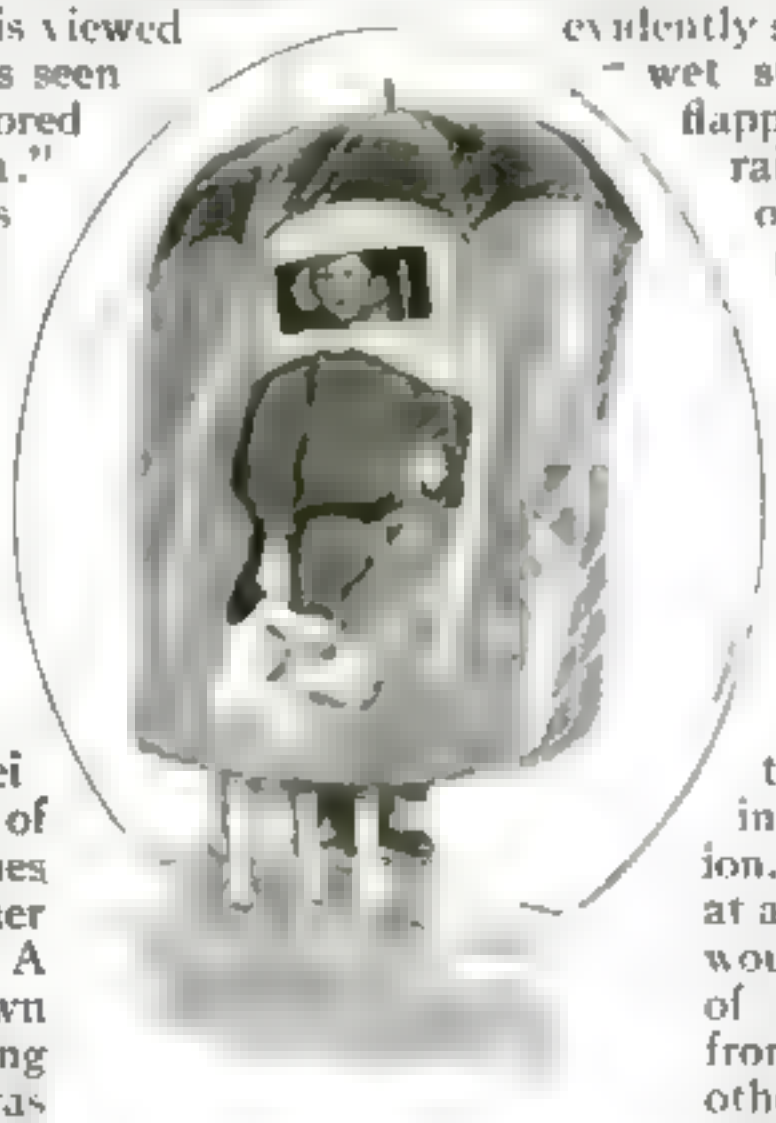


Instrument for measuring the tiny drops of fog. Sixty billion drops equal one-seventh of a glass of water

A Twelve-Year-Old Girl's Combination Umbrella and Rain-Cape

A LITTLE girl, Miss Martha Bachman, who lives in Chattanooga, Tenn., has evidently suffered the discomfort of wet stockings caused by the flapping of her just-so-long rain-cape against her legs on her way to school, as so many other little girls have done in days gone by. But Martha has an idea for eliminating such discomfort from future rainy days.

Her idea is to attach a cape of oil-cloth or rubberized material to the rim of the umbrella with snap-fasteners, buttoning it down the front in ordinary rain-cape fashion. An isinglass window at about the level of the eyes would prevent the wearers of such an umbrella-cape from bumping into each other on the street, like pilotless ships. In this way books could be protected from the rain also and the hand holding the umbrella.

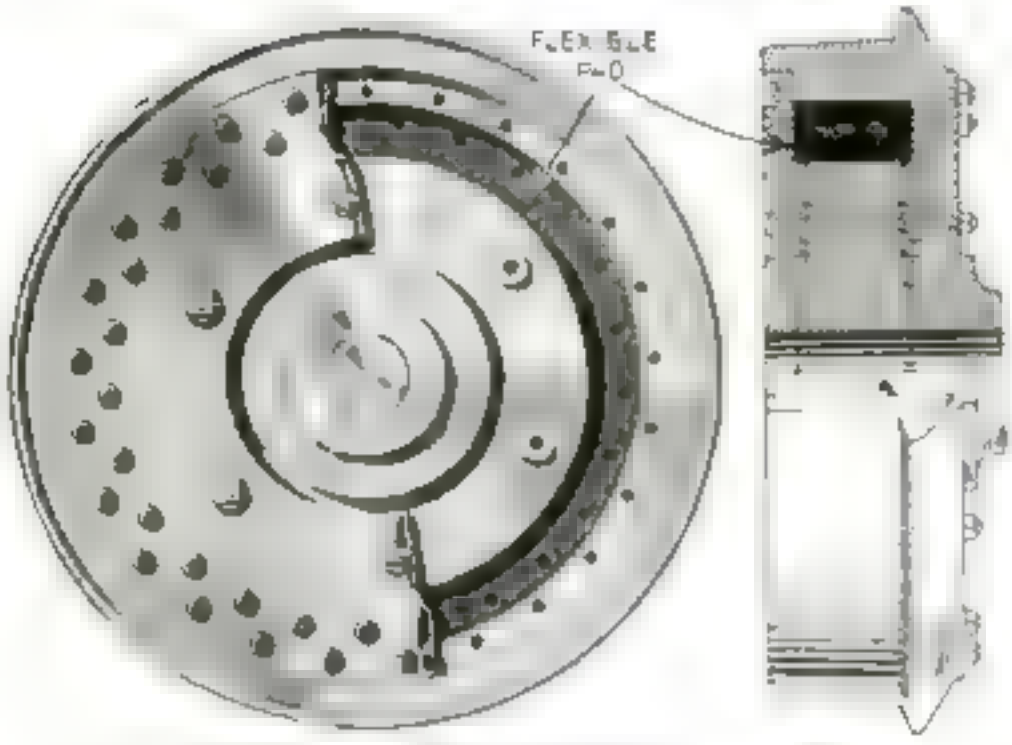


Martha's combination umbrella and rain-cape. Even the dog can crawl under cover

Can the Railway Train Be Made Noiseless?

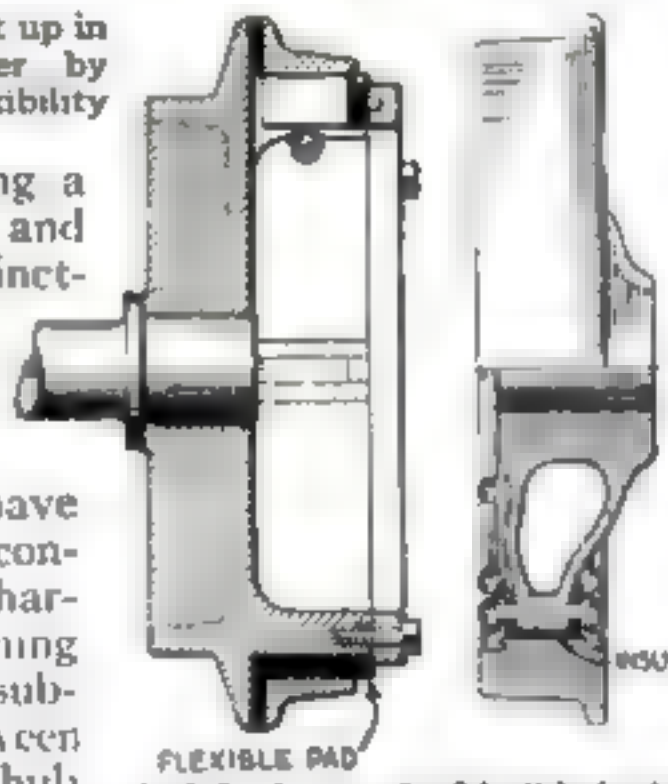
"Yes," say the inventors, "by improving the wheels."
"No," say the engineers, "unless you perfect the road-beds"

By Marius C. Krarup



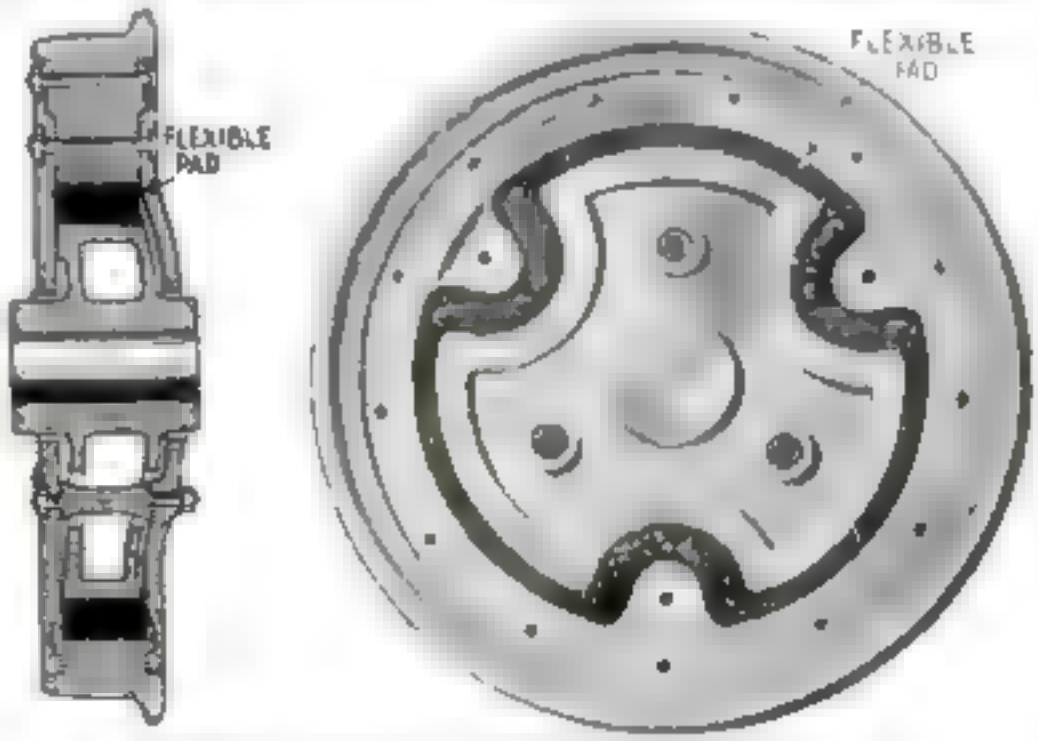
The Maginn wheel is built up in sections secured together by bolts or rivets for flexibility

THE idea of producing a noiseless rail wheel, and even making it distinctly flexible to reduce the wear and tear of the rolling stock has seemed a good one to some inventive minds, and they have proceeded to patent their conceptions. These are all characterized by a noise-deadening and more or less elastic substance which is inserted between the flanged rim and the hub portion of the wheel; by some provision to prevent the rim from slipping round on the inserted material, and by guide plates on the sides to hold the hub and rim in alinement. The details can be followed without difficulty in the accompanying illustrations but are subordinate in interest to the question whether the whole plan is practicable. It is next to impossible to make the "built-up" wheel as cheap or as strong as the one-piece construction. It is almost hopeless to try to introduce a wheel which is after all only a little less noisy than those in use, unless it pays for itself from the start through savings in other directions. If the wheel is frankly intended to be flexible, as the Maginn wheel among those illustrated, it is well to remember that flexibility makes a constant demand on the power of the locomotive. In the Kinsman wheel the main object of inserting a non-metallic substance is to insulate the wheel and the car from the rail electrically, this being a requirement in some forms of electric railway service, and this represents a new angle of the subject having little to do with the other efforts. The Lindblad wheel, on the other hand, is a cushioned and anti-noise wheel with special wiring to prevent it from becoming non-conductive.



At left above, the Lindblad wheel, at right above, the Kinsman wheel

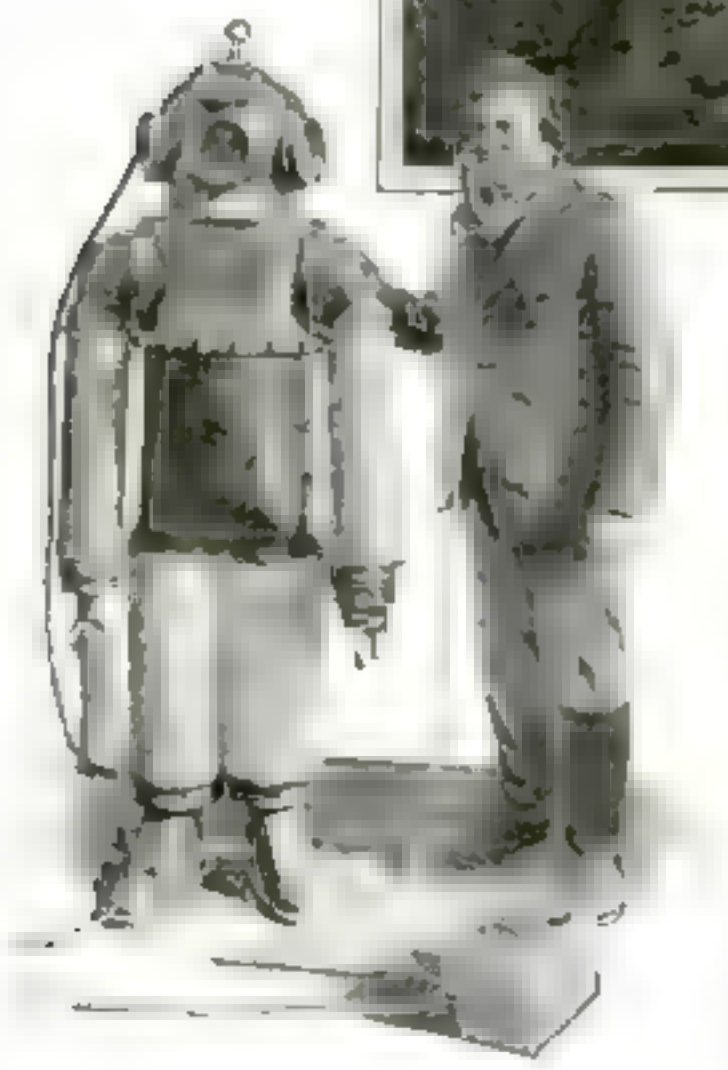
The most radical and efficient method for securing comparatively noiseless operation as well as saving of road-bed and rolling stock, according to modern traffic engineers, comprises thorough grading, draining and ballasting of the road-bed, smooth hard rails of ample dimensions, manganese steel rails at crossings, frogs and improved design of switches, accurately concentric wheels and car springs with well damped and governed rebound. These would reduce noise and improve the service.



The Madden sound-deadening wheel also has a flexible pad which fits like a lining around its rim

The head and body of the suit are of cast metal riveted The arms and legs however, are of can vas reenforced by coils of strong metal tubing. Flexibility is thus given them while their ability to protect the limbs from being crushed by the enormous pressure of the wa ter is not impaired

The heavily laden divers are lowered by single steel cables which enclose the telephone wires through which the orders are trans mitted. Oxygen apparatus is at tached to each suit In this enough oxy gen is stored to last for eight hours. The weight of the suit is an advantage



Salvaging in Armor

As a diver goes down, the water pressure increases at the enormous rate of over three tons a square foot for every one hundred feet. This water pressure is overcome by supplying the diver's lungs with air of an equal pressure. Evidently, the air pressure has to be increased the farther down the diver goes; but if at any time this pressure becomes either more or less than the water outside, the diver will be injured or even killed

This danger is entirely done away with by the armored diving suit invented by B. F. Levitt, of Toledo, Ohio. His suit entirely separates and protects the diver from the water. Manganese

bronze, which is as strong as steel but not so likely to rust, has enabled the inventor to descend to one hundred and twenty feet below the depth attained in the former world's record of three hundred and sixty-one feet. The great strength of this bronze was found capable of withstanding a crushing pressure of some eleven tons per square foot. In marked contrast to the experience of the three divers who made the former world's record—one died shortly after—Levitt experienced no hardships whatever. The air was supplied from an oxygen apparatus attached directly to the back of the diving suit.

The body and the head-piece of Levitt's suit are of cast metal and are riveted together. The legs and arms, however, are of canvas so that they can be bent while the diver is working. These are prevented from collapsing under the water pressure by closely wound coils of strong bronze tubing. The water-tight joints at the shoulders, ankles and wrists run in ball-bearings so the pressure cannot cause them to jam. Obviously, the suit must be very heavy. This fact is by no means a drawback, however, since every bit of the armor's weight is required to make the suit sink down straight. After the suit has been assembled on the diver, he is lowered into the water by a steel cable unwinding from a derrick on the salvaging boat. This cable also serves the purpose of hauling the diver up afterwards. Small telephone wires form the core of the cable and connect the telephone apparatus strapped to the diver's head with similar apparatus on the salvaging barge. Powerful electric lights and carriers for the loads are lowered with the diving corps. This method will be used in an attempt to salvage the *Pewabic*, which went down in Lake Huron nearly fifty years ago.

Dummy Guns and Turrets Train England's Gunners for the Sea

WHEN England trains her gunners for the sea, she sends them to Whale Island in Portsmouth Harbor. Here the entire island is given over to steel sheds which are built like gun turrets on a battleship. The great guns projecting from these sheds are dummies, though they are exact counterparts of those on a battleship. The prospective officers and men are made to go through the exercise of range-finding, loading, aiming and "firing" these guns as rigidly as if they were in a real battle at sea. The heavy steel projectiles are hauled from the magazine by hydraulic and electric cranes just as in an actual ship. A real breech mechanism locks the projectile and its powder charge in the gun while an intricate swivel mounting of steel swings the gun into the firing position.

The great guns projecting from these sheds are dummies, though they are the exact counterparts of those on a battleship and can be loaded, aimed and "fired" by the recruits in training

The Straw Hat for Storms. The Top Turns Inside Out

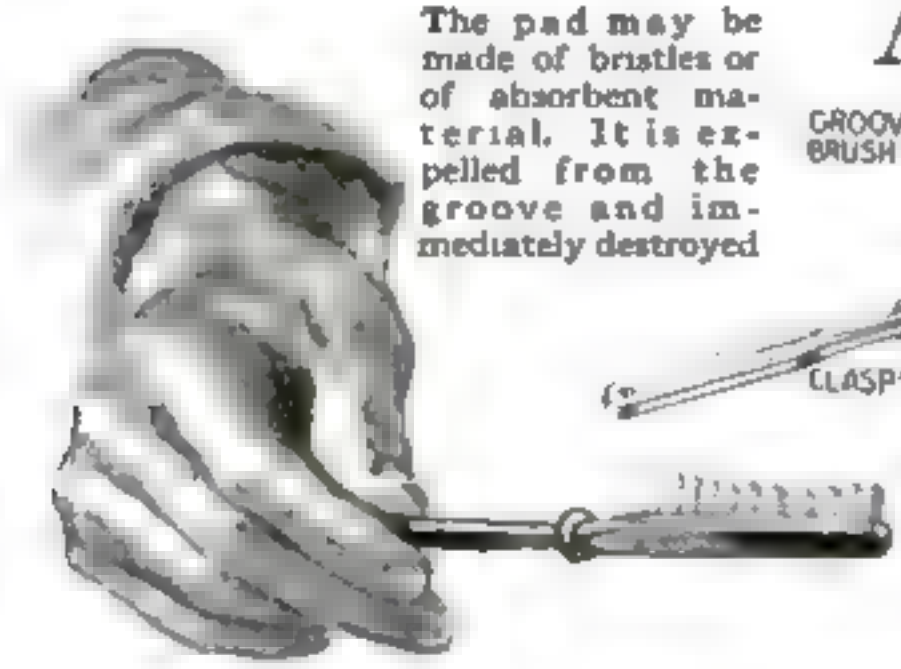
A STRAW hat which can be taken out in the fiercest storm with impunity is a recent invention of William Wilson, of Newark, New Jersey. There is nothing exceptional about the straw. The top of the hat, however, can be turned inside out. The folded waterproof covering that is thus exposed can be drawn over the entire upper surface of the hat

Ordinarily the waterproof cover is concealed beneath a cloth lining under the top. An elastic band keeps the lining drawn up tight.

When it rains, the top of the hat is swung around and the elastic covering carried underneath the lid is drawn down over the entire hat

Arthur Picard, a resident of New York city. It is in three sections—a handle, a sliding support for the pad, and the pad itself which may be of bristles or of absorbent material. The sliding support has side jaws which clamp the pad securely in place when the ring shown on the tapered portion of the handle is pushed up as far as it will go on the pad-holder. To release the pad, the ring is slipped down on the handle, and the tongue in the groove of the pad-support is pushed up. This expels the pad from the groove.

A Toothbrush for the Sick—It Has a Removable Pad



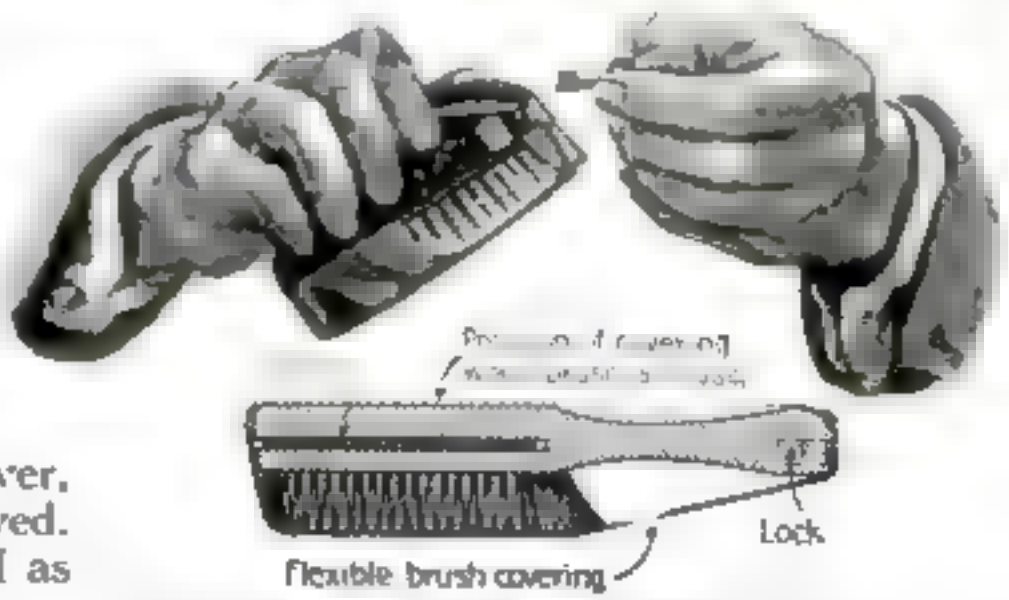
The pad may be made of bristles or of absorbent material. It is expelled from the groove and immediately destroyed

THE toothbrush of an invalid should be destroyed after a single use. That is the practice in the more carefully conducted hospitals. Ordinarily this would necessitate having on hand a goodly supply of brushes if the patient's teeth are to be properly cared for. With the type of brush shown in the illustration, however, only the pad, or bristles, need be destroyed. The handle may be sterilized and used as long as it lasts.

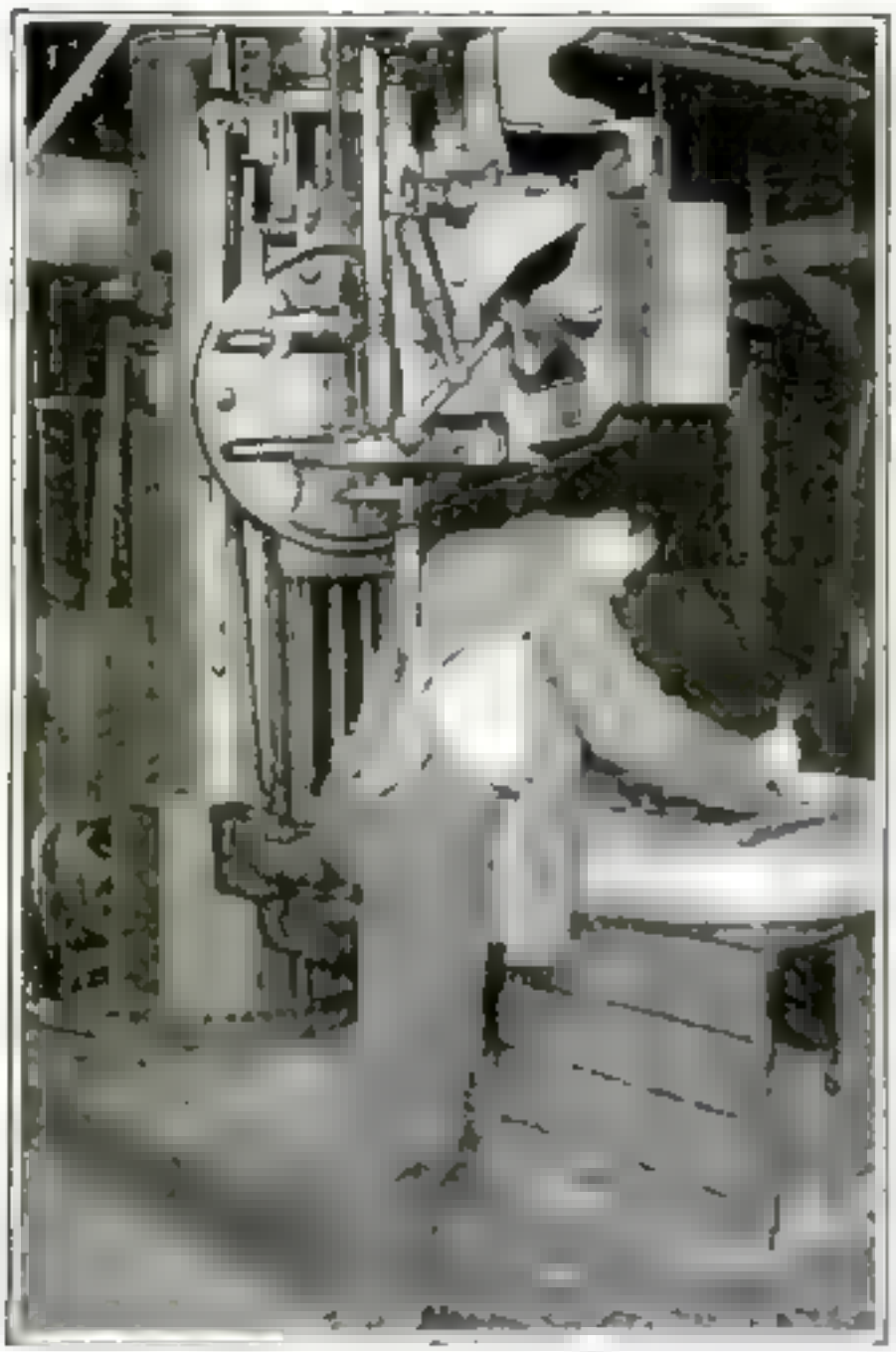
The brush is the invention of Alphonse

The Private Hairbrush—The Bristles Can Be Locked Up

APPARENTLY only one man of inventive genius in all the United States has been able to remain unaffected by the zip-boom-bang of guns and war news and to apply his talent to the crying needs of everyday and home. He has invented a device for locking up his hairbrush to protect it from the other boarders in the house! It is in the form of a cover tacked to the back of the brush and with overlapping sides which fasten with lock and key.



The cover is tacked to the back of the brush. The sides fold over and are fastened with lock and key



The coat is fastened together in sections so that it pulls apart readily when caught

A Safety Coat for Workmen. It Pulls Apart in Sections

TWO million machineshop workers in the United States read safety bulletins each week and operate machinery equipped with every kind of safety appliance which money will buy. Yet not a week goes by but several careless workmen are injured and one or two killed outright because of their own recklessness. One of the most common forms of accidents is the catching of loose and exposed garments in revolving shafts, pulleys and other moving machinery.

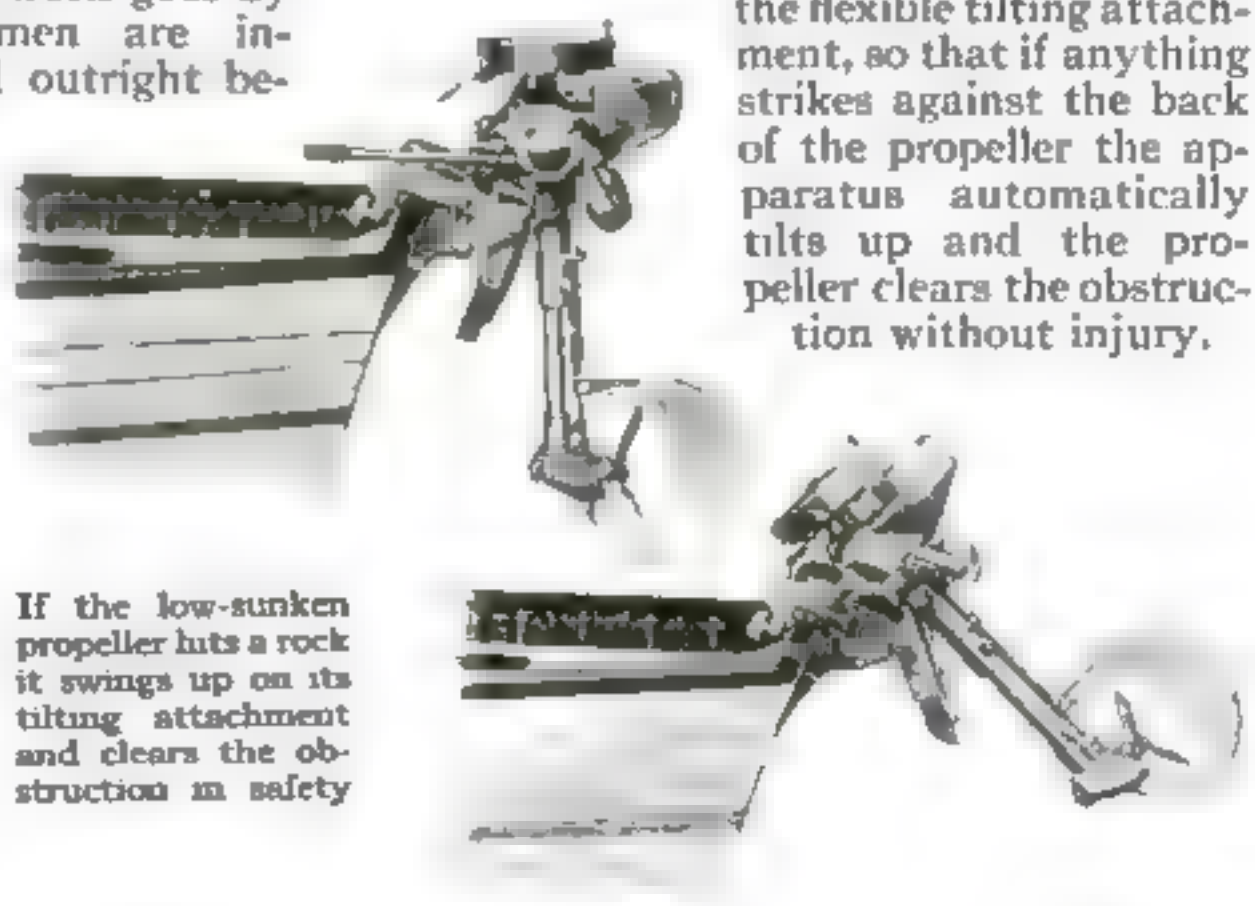
Only recently a man wearing a ragged sleeve while turning a bolt on a machine in an Omaha shop was stripped to his waist. By a miracle his life was saved. Had he worn the safety garment illustrated on this page he would have lost part of the coat only. Herbert P. Andrews, of Portland, Oregon, the inventor, has designed the coat in sections in such a way that any unusual pull on any particular section will detach it bodily from the rest of the garment.

The coat is not sewed together at the seams, but is fastened, one section to the other, by snap fasteners. Thus any section may be detached without tearing the rest of the garment or endangering the life of the wearer. If the workman is fortunate enough to see the machinery catch his coat, he can pull himself away instantly, losing only one section of the coat. The snap hooks and fasteners do not detract from the general appearance of the coat, and it meets all the demands for ordinary wear.

Motor Attachment Which Prevents Injury to Rowboat Screw

WITH the marketing by a Western concern of a tilting motor attachment, the motor-driven rowboat comes into its own. In the past when beaching the boats or when passing through shallow water, the propellers of rowboats using motor power were endangered. In a boat of such light draft as the rowboat, the propellers have to be held below the bottom of the boat to afford it sufficient "push." This, of course, is unsafe; for in beaching the boat, or in passing a rock or a snag in shallow water, the propellers are likely to be snapped off or bent out of alinement.

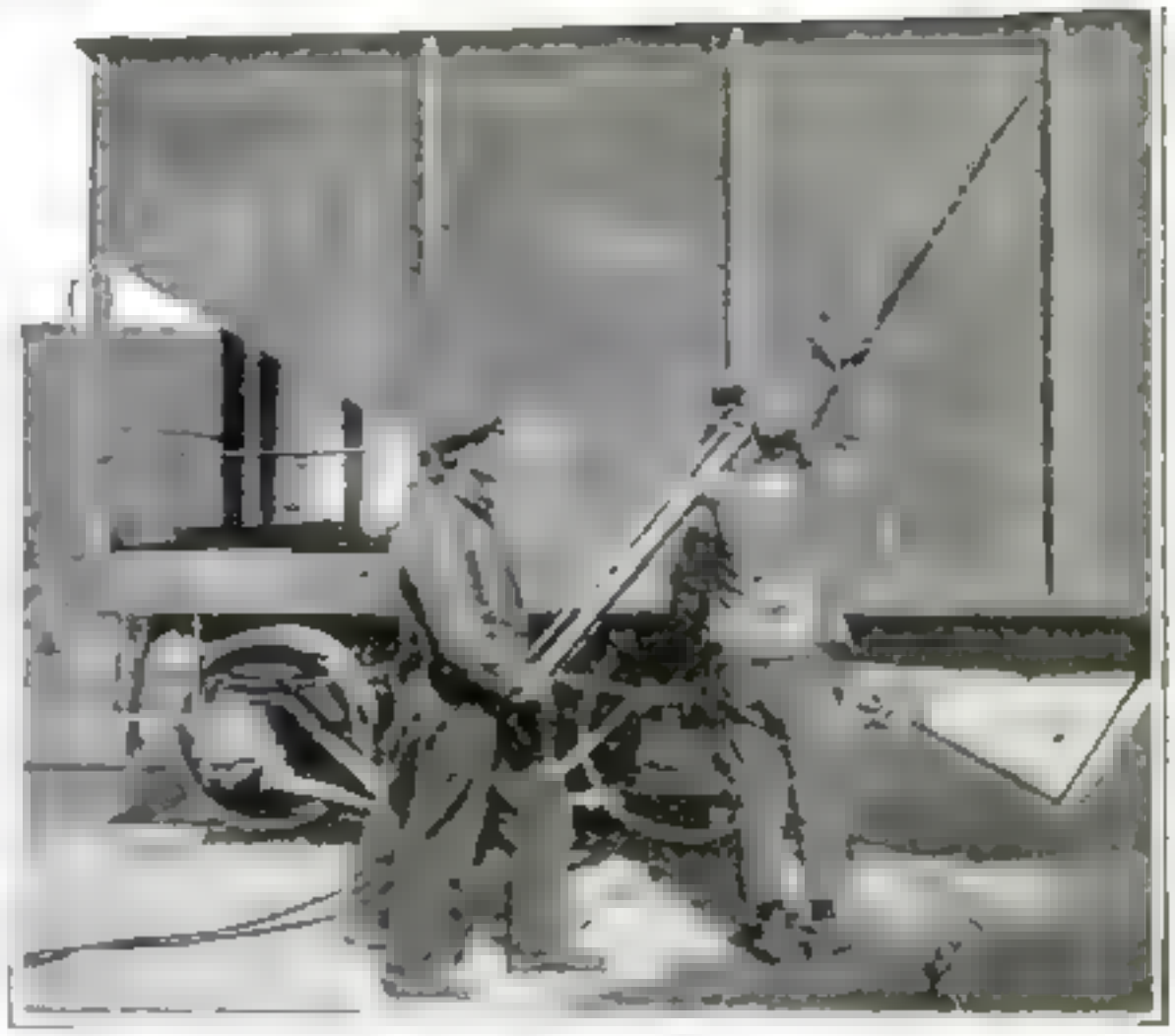
The tilting motor attachment prevents such an accident. The entire propelling apparatus is mounted on the flexible tilting attachment, so that if anything strikes against the back of the propeller the apparatus automatically tilts up and the propeller clears the obstruction without injury.



If the low-sunken propeller hits a rock it swings up on its tilting attachment and clears the obstruction in safety

It Stormed; So the Funeral Was Conducted by Telephone

FROM Wisconsin comes the report of a funeral by telephone. A Methodist minister, of Oakfield, died and his bishop was to deliver the funeral sermon. But a severe storm came on and the bishop, who was on his way, saw no chance of getting to the village, since traffic was stopped on the short branch line leading to the place. Stopping at a farmhouse to telephone his predicament to the waiting family, he decided to conduct the service over the telephone, one of the members of the family repeating his words to the mourners



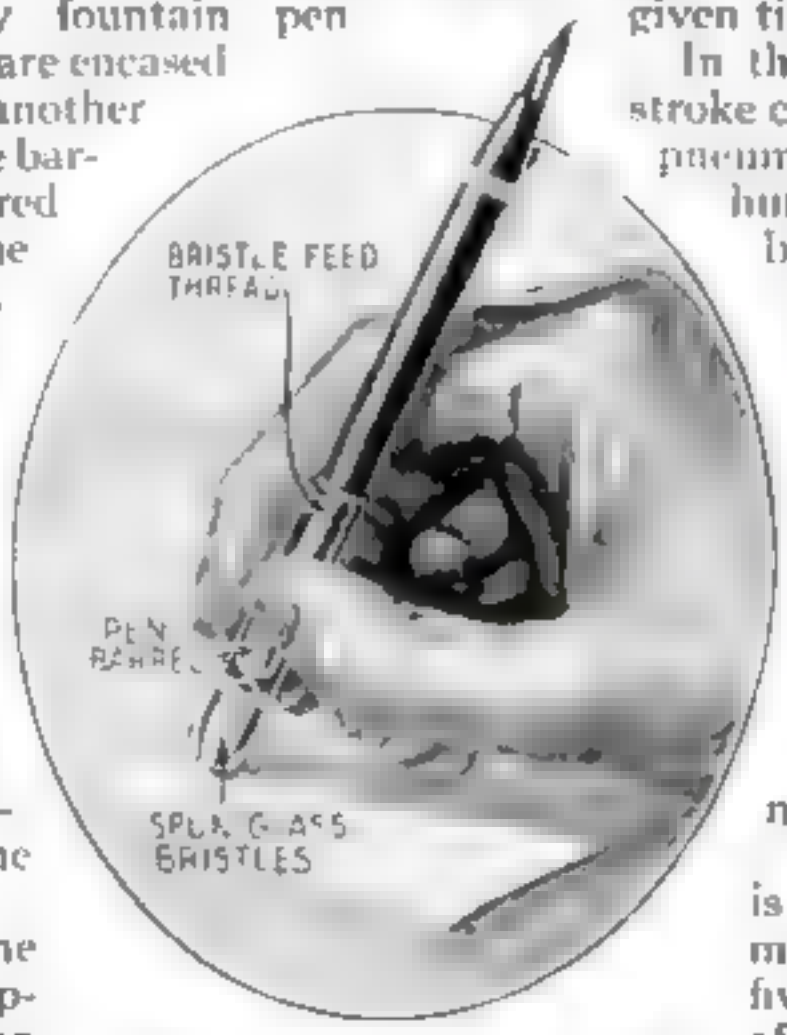
Compressed air pumped into the cylinder rapidly vibrates the cutting bar as would a short-stroke reciprocating engine

The Last Word in Fountain Pen Efficiency—An Eraser Attachment

IF you should make a mistake while writing, the fault is yours, not your pen's. However, your pen may be made to correct the mistake very neatly. Daniel R. Markley, of Lancaster, Pa., has devised a plan for attaching an eraser composed of threads of spun glass to the top of the barrel of any ordinary fountain pen

The spun-glass threads are encased in a cup which is held in another cup which screws on to the barrel of the pen and is covered by a cap resembling the one which covers the pen. The inner walls of the cup holding the bristles, or threads, converge at the outer end so that the bristles are held in a compact little bunch, as shown in the illustration. As the bristles at the end are worn away the remaining lengths may be fed through automatically by screwing the cup further up.

The addition of the eraser does not alter the appearance of the fountain pen in any other way than by slightly increasing its length.



Bristles of spun glass are fastened in a cup threaded on the barrel of the pen for an eraser

Removing Iron Rivets with a Pneumatic Hammer

THOUGH the pneumatic hammer has long been used in structural steel work to shape the heads on red-hot rivets, the old hammer-and-bar methods are still used in removing the rivets. A pneumatic hammer has been invented, however, which removes fifty times as many rivets in a given time.

In the time that one hammer stroke can be given by a man, the pneumatic hammer gives several hundred. The long cutting bar is attached to a piston in a long cylinder. Air is pumped to the cylinder under pressure of one hundred pounds per square inch, and it immediately vibrates the bar violently. When the crew press the hammer against a rivet, the pounding knocks the rivet's head off almost instantly.

This method of cutting is not only easier for the men, but it saves seventy-five per cent on the cost of the hand method. Moreover, it can be used in ordinarily inaccessible places.

Giving Convicts a Real Chance

How the Prison Farms of Florida have superseded the inhuman leasing-out system

By Ewing Galloway

A gang of convicts at Bradford Farms grading a lot for an electric powerhouse, ice plant and steam laundry. One of the two locomotives belonging to the prison is seen in the background

A FEW years ago Florida's penal system was one of the cruelest, the most brutal that ever existed in the United States. All able-bodied male convicts were leased to private concerns to work in lumber and turpentine camps, and thousands of them were overworked, underfed, and housed in cages unfit for wild beasts. Often those who failed in the slightest degree to please guards or overseers were beaten unmercifully.

Magazines and newspapers revealed the truth about the lumber and turpentine camps, and as a result of their exposures the State Government established a prison that might serve as a model for agricultural states or principalities throughout the civilized world.

In 1913, after thirty-three years of leasing out all convicts capable of earning money for private concerns, the State authorities bought 17,000 acres of pine forest and swamps in Bradford County and started the development of what is now known as Bradford Farms. In November of that year crews of convicts began clearing and draining this tract of wilderness and laying the foundations of some of the buildings. To-day they have three thousand acres in a high state of cultivation, a prison town of thirty-five buildings, all the implements, livestock and poultry they can use to advantage, and a steam railroad of their own construction running to all important sections of the plantation.

Offenders serving time at Bradford Farms are not made to feel that they are despised outcasts upon whom the State is wreaking vengeance. They are treated as misguided persons to be corrected morally and trained for lives of usefulness. They are given wholesome food, housed in clean, airy buildings, encouraged to improve their personal habits, and employed at healthful and instructive labor

The wards are as light, clean and airy as the State could make them. The men rise at 4:30 and retire at 7.30

The field laborers work only nine hours a day, which is about two hours less than the time spent

The stables and shops of the model prison farm. The land shown in the photograph was a wilderness of pine forests and disease-breeding swamps before the convicts improved it

each day in labor by the average free farm hand in the South. They take three hours, exclusive of the time spent en route to and from the stockade, for rest and dinner in the middle of the day.

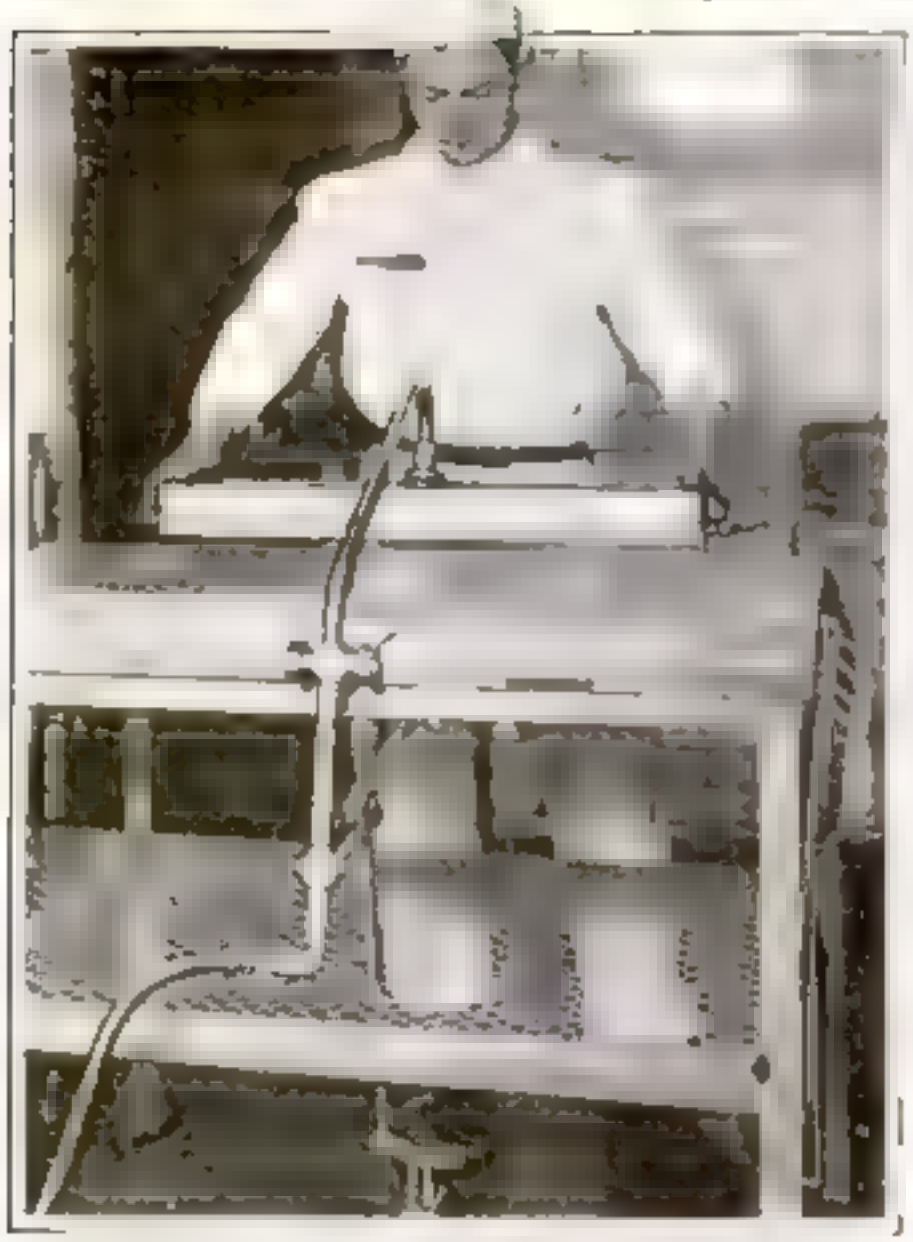
They grow cotton, corn, sorghum cane, potatoes and all kinds of vegetables, and raise cattle, hogs and chickens. Last year their Irish potato patch was 550 acres, and an even larger area was given to sweet potatoes.

The methods of crop cultivation and livestock raising that have been adopted are the best known to the State Department of Agriculture. The Commissioner of Agriculture, William A. McRae, sees to it that all the work is done in the best possible manner. The result is that practically all persons released from Bradford Farms are highly skilled farm workers. The more intelligent ones are well trained in farm management also.

At the present time the prison population at Bradford Farms is approximately 650. About 250 are leased to counties to work on public roads. There are 736 working for private corporations. But the lease law of to-day is not like the old one. It places the working of leased convicts under rigid State inspection, and gives the Commissioner of Agriculture the right to cancel contracts whenever lessees fail to treat prisoners humanely. Only negroes of low-grade intelligence are leased, and the contracts are limited to two years.

There is a rapidly increasing sentiment in favor of abolishing the lease system and sending all the State's convicts to Bradford Farms during imprisonment.

This gives an idea of the work the convicts accomplished in converting the three thousand forest acres into tillable land



The inflow of compressed air is controlled by a foot-treadle so that the hands are free to move the block to and fro under the pipe mouth

With the Warm Weather Come Improvements in Ice-Cream Making

THE ice-cream manufacturer encounters the same difficulty in removing blocks or forms of cream from their molds as does the average cook or housewife with her frozen desserts.

A recent device, patented by L. M. Hendler, of Baltimore, Md., for overcoming this difficulty, is a contrivance for forcing warmed air through a pipe to the bottom of the mold to dislodge the bricks of cream. This is more particularly for the convenience of dealers who handle large oblong blocks of cream which must afterward be cut up into the smaller bricks The valve which controls the compressed air inflow is conveniently operated by a foot-lever.

Why Not Dress Alike and Save Money During War Time?

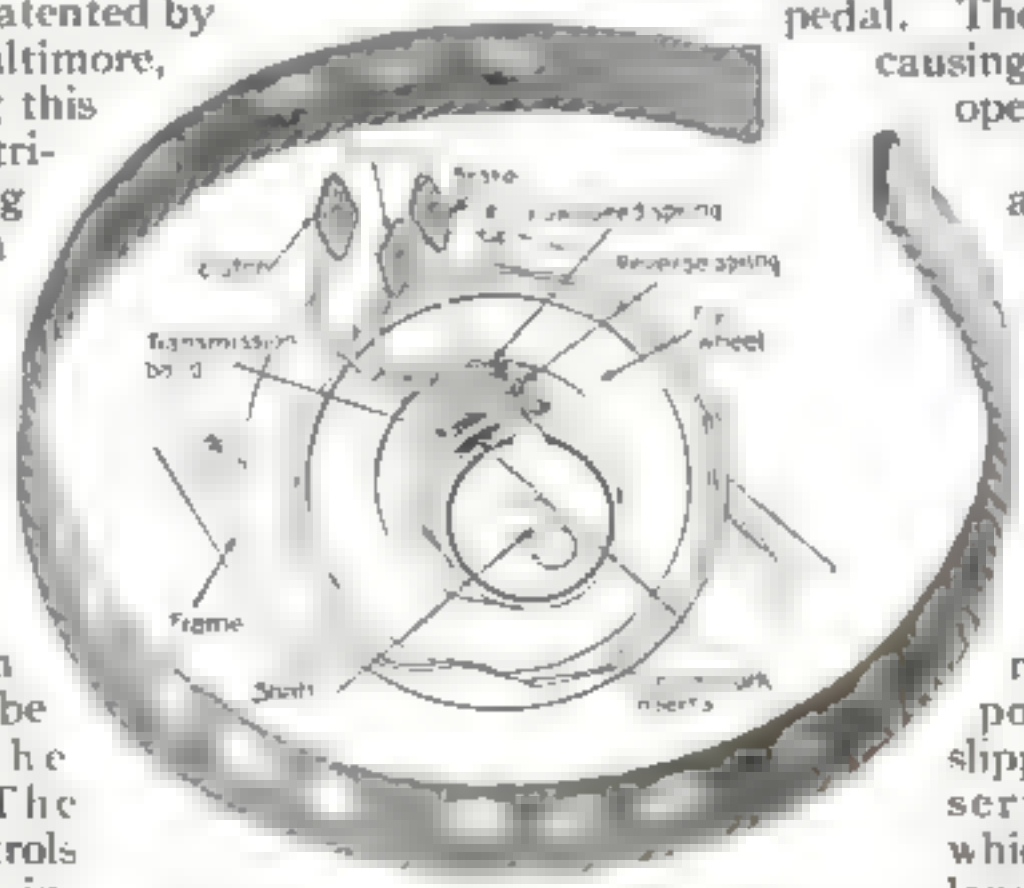
WHY not a civilian uniform as a measure of economy in clothing? suggests a Canton, Ohio, man. It could be worn by everyone, man, woman and child, and thus eliminate foolish dressing, the dude, and the spending of hundreds of thousands of dollars on needless finery. It would certainly bring home to the civilian population their part in the war, and the ladies would need to apologize no longer for appearing twice in the same dress. As the result of investigation carried on by the Ohio man, a standardized suit of wool of excellent quality could be sold for less than twenty dollars.

A New Type of Transmission Employs Cork Inserts

THE new type of transmission band shown in the accompanying illustration is designed to overcome the objection to the planetary form of transmission, such as used on the Ford car. It has cork inserts like buttons. These extend out beyond the band proper for a very slight distance and come into direct contact with the revolving drums as the speed is changed.

On account of the high coefficient of friction of cork and steel, the braking effect commences at once, whereas the plane surface fabric band usually fitted slips as it becomes worn and glossy and does not grip except when an excessive amount of pressure is exerted on the transmission pedal. Then it grips suddenly, causing a jarring in the operation.

The cork buttons also act as springs; for as the pressure increases they are compressed, thus allowing the band itself to come into contact with the drum. This makes an easily operated transmission which acts positively without slipping, even after long service, and one in which the bands have a longer life due to this practical elimination of the slipping.



The transmission band with cork inserts, encircling a diagrammatic drawing showing the band in use on the automobile

This Actually Happens Oftener Than You Would Think

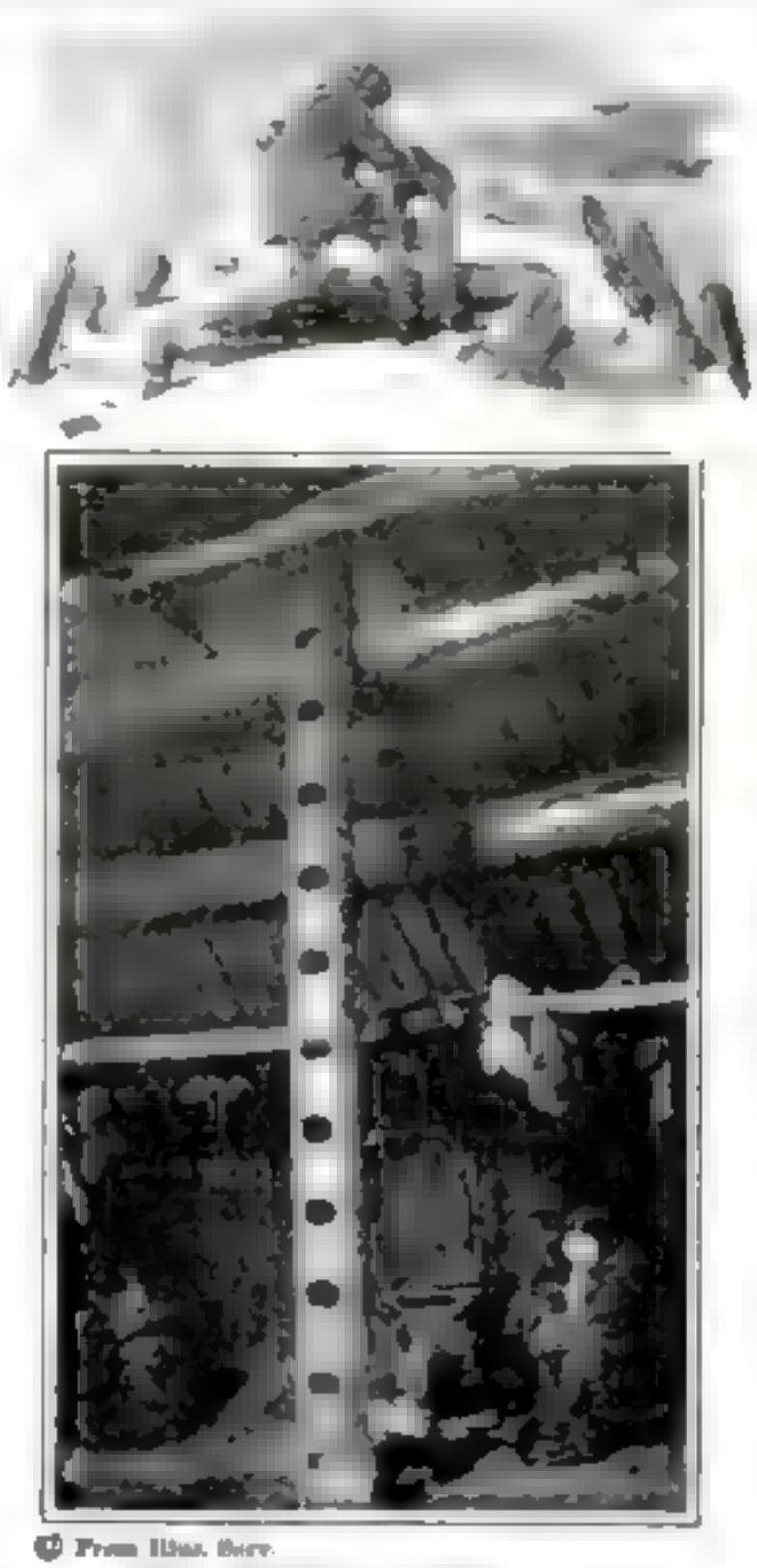
IT may be a mere matter of superstition which causes so many hundreds of soldiers to wear small Bibles and Testaments over their hearts. But the Pocket Testament League of England reports that it is very generally done, and occasionally we hear of incidents which confirm the report of the League. Superstition says that the heart so protected will never be pierced by a bullet. Certainly the soldier who wore the little volume shown in the accompanying photograph must be a firm believer in its efficacy. He was struck by two machine bullets. One of them remained in the Testament, though practically destroying it. The other passed through it and penetrated his ribs, but without causing serious injury.

Superstition also says that if the Testament be the gift of a mother or sweetheart it is doubly valuable as a talisman.

Notice the face on the right-hand page.

Two bullets pierced the little pocket Testament without doing the wearer any serious harm

The Door to This Siberian Home Is Located on the Roof



© From Ilius. Surv.

The Siberian native enters his home by a ladder leading from a door in the roof

MUCH of Siberia is a vast wilderness which still remains to be explored. In the winter season, when the streams cease to flow, disappearing beneath the ice and snow, the animals hibernate in their dens and the natives repair to their huts to sleep away, so far as possible, the infinite silence that broods over the land.

The illustration shows the interior of a Siberian home. The odd-looking ladder in the foreground leads to the door of the hut, which is situated in the roof. The ladder is hewn from a big log and the hole rungs in it have all been cut by hand. It is necessary to enter a Siberian home through the roof during the severest winter months, because the snow, driven by the gales of the North, forms great drifts which not only effectually cover up all side entrances but often conceal the whereabouts of the hut itself.

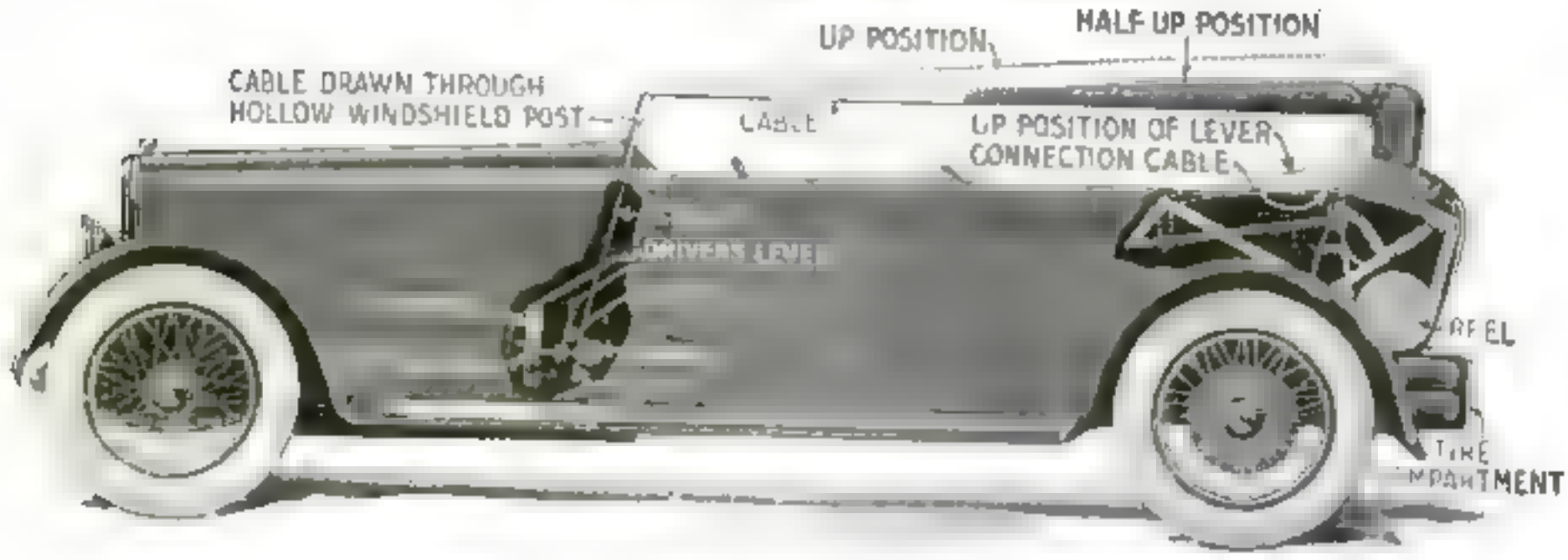
Have You Put the Cat Out for the Night? Then Don't

Says Lee S. Crandall, in *Pets* (Henry Holt & Co., New York): "The practice of turning the cat out of doors at night is as cruel as it is unnecessary. No animal is fonder of warmth and comfort, and the pet's happiness certainly is not increased by a night spent outside in cold and dampness.

"If as much energy were exhausted in keeping the cat indoors as too often is expended in putting her out, how great would be the boon to human nerves and unfortunate wild things! All felines are normally nocturnal, and it is at night, if ever, that a curb on their activities is needed."

The Problem of the Automobile Top

It may be made self effacing and self-adjusting

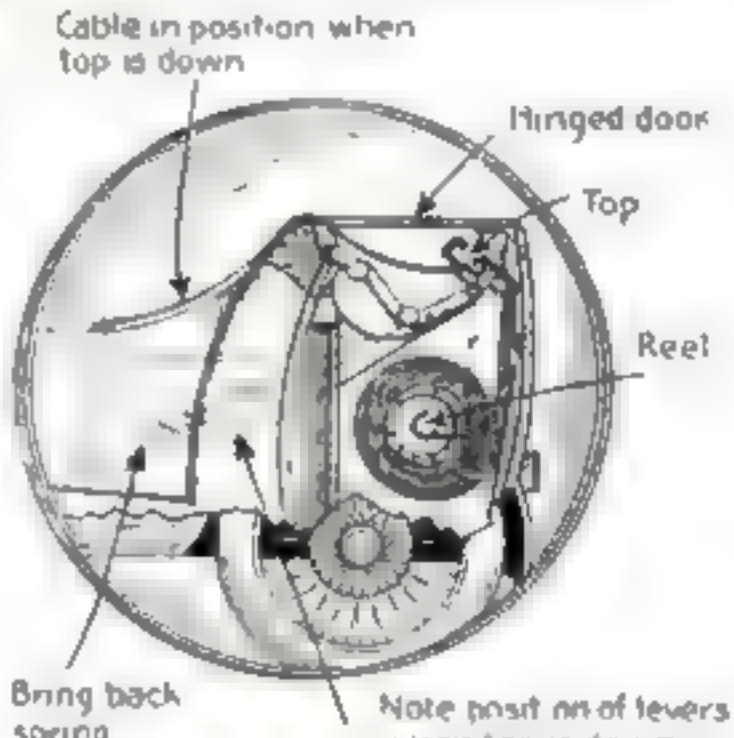


The automatic top is not only raised and lowered by the power of the engine but it is stored away out of sight in the extended rear end

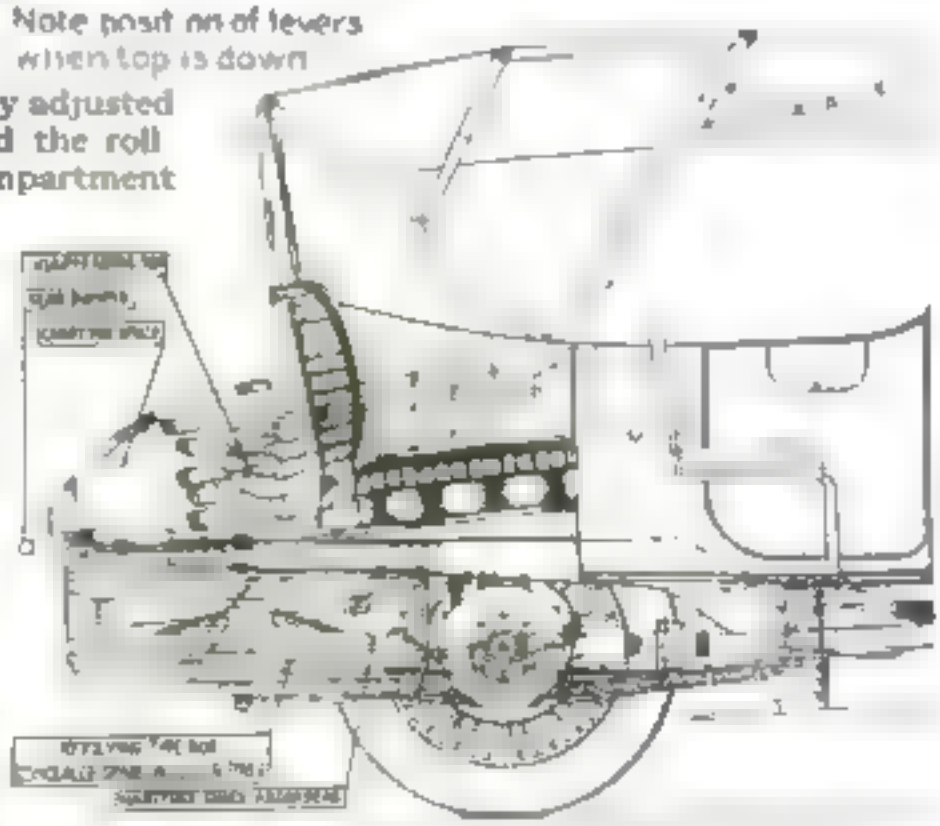
ONE of the most conspicuous and ugly parts of the average automobile is the top. Folded, it is an overhanging object at the rear out of harmony with the pleasing lines of the body.

To eliminate this unsightliness, the engineers of two large companies have designed two types of disappearing tops which are entirely hidden when not in use. Both of these are shown here. One is raised by hand. The other differs from all other types of tops in that it is automatically raised and taken down not by hand but by power secured from the vehicle's engine, a convenience especially attractive to thousands of women drivers.

When not in use the hand-raised and lowered disappearing top is stowed away out of sight in a turtle-backed compartment at the extreme rear of the car behind the rear seat. This turtle back serves as a cover but also gives the body the lines of a yacht. The top is inserted in the rear compartment through a large U-shaped door in the top and two smaller doors on the sides of the rear seat, all three doors forming one large U-shaped opening when they are revolved up about their respective hinges. The side arms supporting the top, when up, are pivoted at opposite points inside the compartment. Suppose the top is to be lowered. The chauffeur walks to the rear of the car through the divided front seats and folds the top away in the conventional manner. When the three doors are closed it is entirely hidden from view. An eave trough is provided in front of the doors so that water cannot leak through the door joints and down into the compartment where it might rot the



The automatically adjusted top wound round the roller in the rear compartment

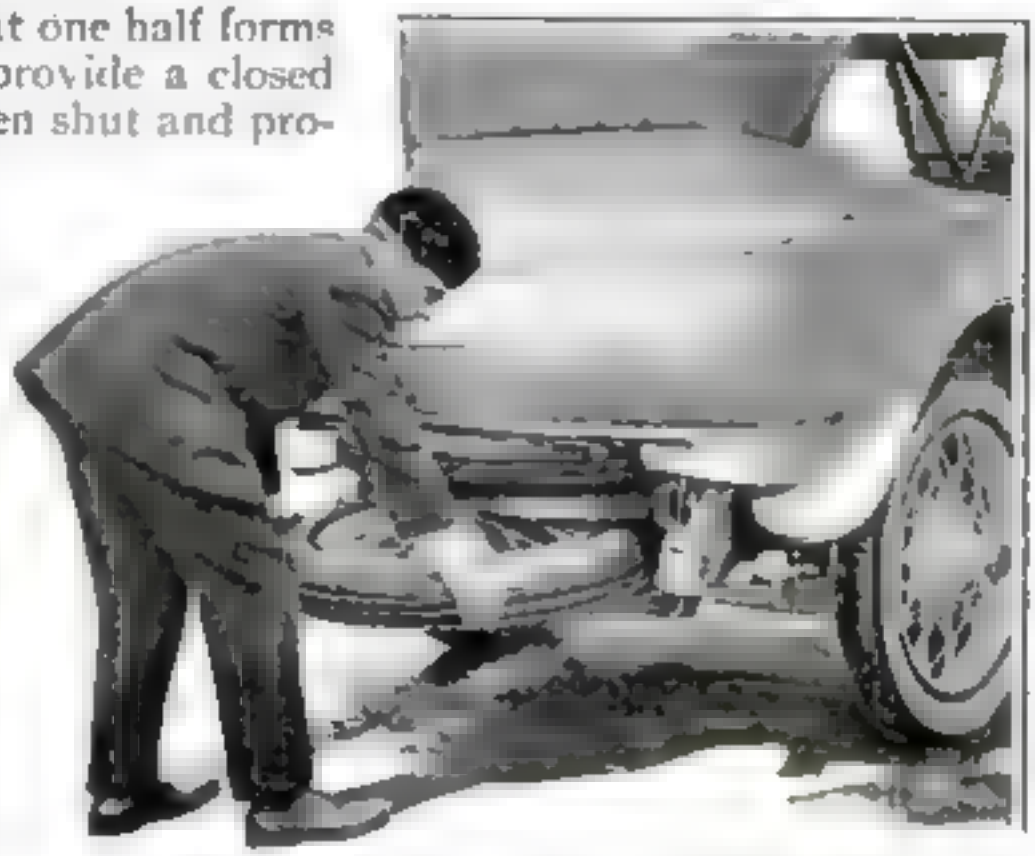


The hand-operated top is folded back in the usual way and then stowed away out of sight in a turtle-backed compartment

top if allowed to accumulate. The water drains off the eave trough through pipes to the ground.

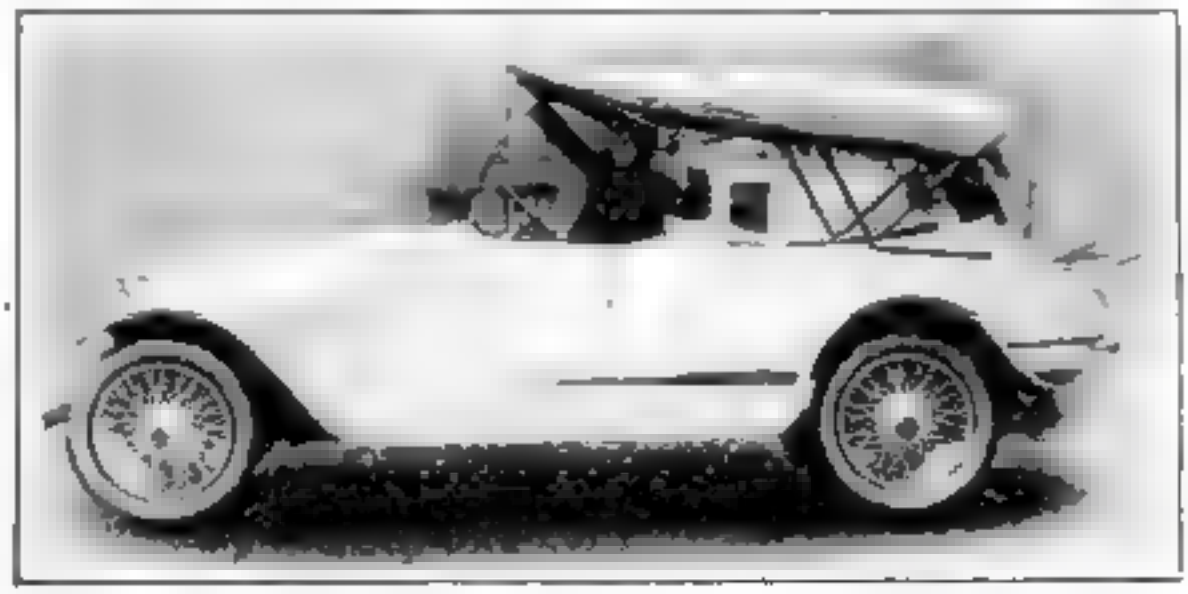
Another feature of the turtle back is a tire-carrier directly under the top compartment. The carrier is made of two semi-circular halves mounted on a central shaft so that one half forms a curved door to provide a closed cylindrical box when shut and provides access to two horizontal shelves, each of which carries a tire, when open. This arrangement is especially convenient because it eliminates lifting and strapping the tires upon a conventional carrier.

The automatic top differs from that just described not only in that it is raised and lowered by the power of the vehicle engine instead of by hand but that it is stowed away out of sight in the extended rear end of the body without any turtle back. When not in use the top is wound around a horizontal crosswise roller in the rear compartment. The front end of the top is drawn forward to the windshield by means of two steel cables which extend down through the hollow windshield side posts to a small spool drum revolved through a friction gear from the engine flywheel. The operation of drawing the top forward out of its compartment and winding the two cables around the drum is controlled by a small lever manipulated by the driver. The winding drum is revolved through a set of gears and a clutch under the floor of the cab The top compartment is closed by a door restrained by springs and so arranged that a push on a small button by the driver automatically opens it. The manipulation of the drum lever draws the top forward in ten seconds. It is automatically stopped when it reaches the windshield.



A separate compartment to carry extra wheels, a feature which distinguishes this car from all others

To lower the top the operations are reversed, the cables being disconnected at the windshield and the top drawn back by a spring-reel at the rear. The free ends of the cables are laid in small grooves in the body sides in the way of the rear seat where they are easily reached by the driver. When up, the top is prevented from sagging by means of three thin strips of spring steel wound with it around the roller. The spare tires are carried in a horizontal position beneath the top roller in the rear compartment.



Raising the top after removing it from its hidden position in the turtle backed carrier at the extreme rear of the car

A Vast Fortune Is Chewed Up Every Year

LOUD and long are the complaints of the stringency of the times and the wails concerning the tightness of money; but these laments are not coming from the manufacturers of chewing gum. Neither the war nor any other calamity has affected the output of this great necessity. The annual imports of chewing gum average about 7,000,000 pounds, although in 1913 the average reached nearly 14,000,000 pounds. Thus it is estimated that $13,000,000 are chewed up annually.

Electric Newspapers in the Sky

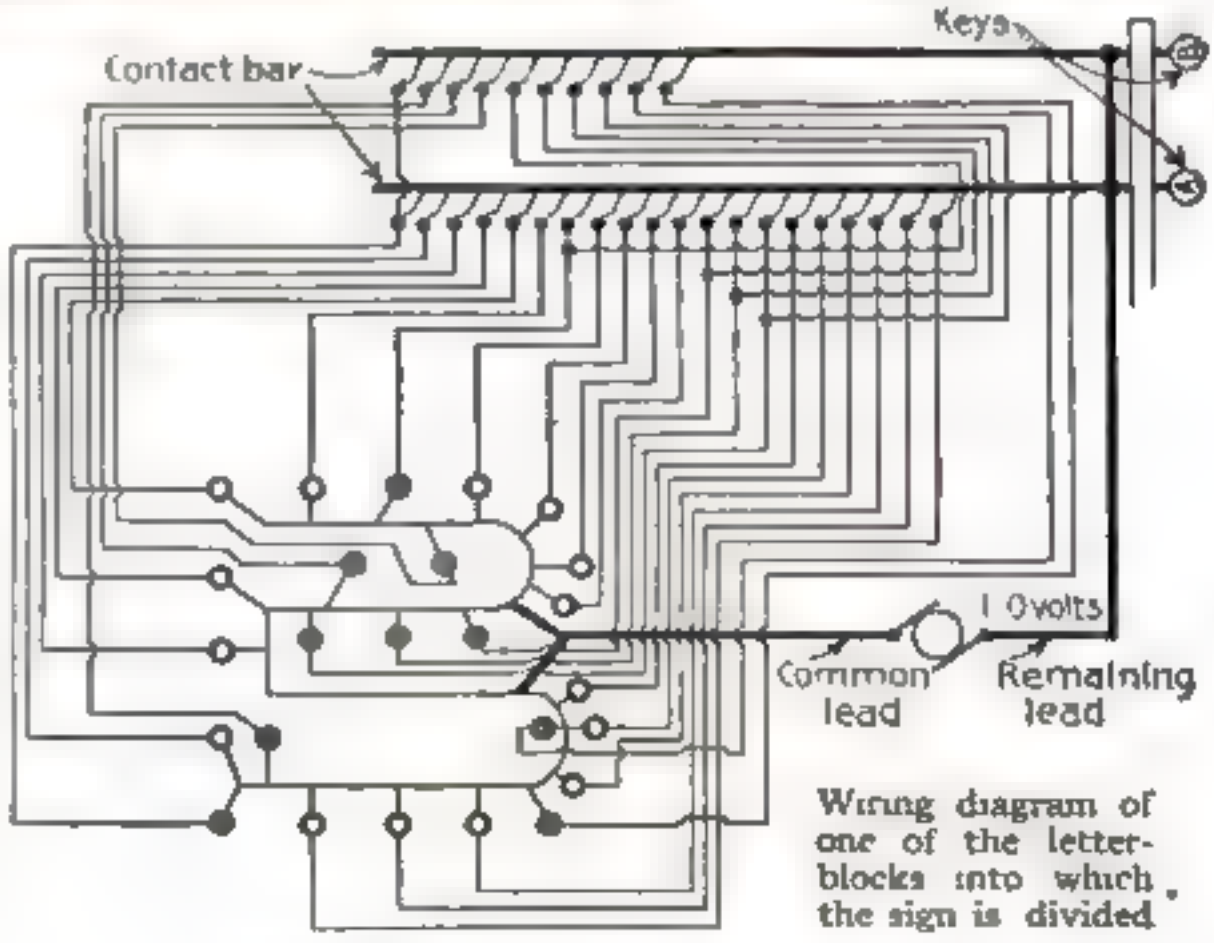
**They flash information in flickering tidbits—
a fresh, dazzling morsel every ten seconds**

ANY evening now in Chicago you can look skyward and read, one after another, flaming messages to the general public. Up on top of some tall skyscraper is the contrivance that delivers these messages. It is a form of electric sign, at a distance differing but little from the ordinary kind, except that the messages it blazons forth change with far greater rapidity. In the darkness the framework of the sign is invisible; the separate letters seem to stand out like so many stars against the inky sky behind. Inside a little coop behind the sign young men are punching small keys in an immense keyboard—setting up in electric type messages that come from various parts of the city, from the war zones; in fact from all over the world. For this is the newest form of newspaper—a newspaper in the sky! It prints all that the ordinary paper does, excepting cartoons—news, advertisements, catchy sayings, sporting comment, anything that is the life of the ordinary penny sheet. And its public is even as big!

Where old bulletin boards could dole out limited bits of information to a few within range of thirty or forty feet this new signboard flashes its intelligence to thousands anywhere up and down the long ranges of two intersecting streets.

To change the wording of the sign men do not shift the letters bodily as in an ordinary theater bulletin board. The separate letters forming a given message simply go out, and others, expressing a new idea, light up in their places. This is possible because the sign is divided off into squares, called "letter-blocks," each the size of an ordinary letter, and each having fifty-three lamps scattered over its surface in such a way that by picking out the right lamps in a given instance any letter in the alphabet may be made to appear in that space at will. When the operators punch keys in the keyboard

One of the newspaper electric signs overlooking Longacre Square, in New York city

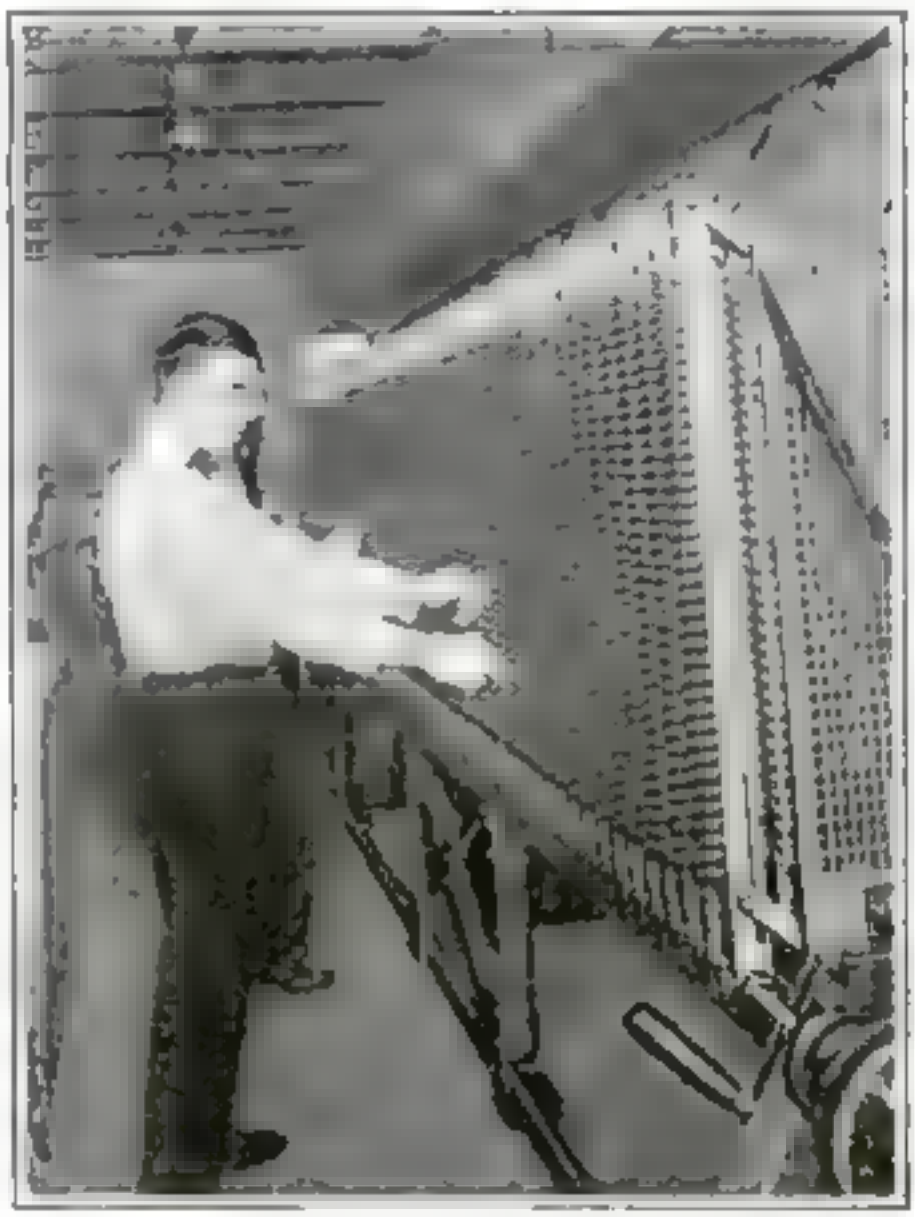


Wiring diagram of one of the letter-blocks into which the sign is divided

previously mentioned they simply cause switches back of each key to pick out the right set of lamps to blazon forth the letter it is desired to show in a given letter-block. Since the letter-blocks are arranged in long lines it is possible to spell out words and phrases, simply by causing the individual letter-blocks to show the character desired. The principle is made clearer in the illustrations.

Changes in the wording of the sign are effected as fast as the operators can work the keyboard—one man devoting his entire attention to a single line on the sign, but together with his fellows getting orders from cardboards in the hands of the chief operator. A given message is made to flash on the sign very much as type is set up on a linotype machine. In the linotype case the printer punches proper keys to spell out one line, strikes a lever convenient to his right hand, and the matrices pass on into the machine to mold the type while he is busying himself with the next line. In the same way, the operators of the new sign punch proper keys to spell out a given message, strike a lever, and the message flashes on the sign. While people are reading it, the men are setting keys for the next communication, which appears the next instant.

The sign was originally patented by W. W. Arnold, of Hamilton, Ohio, but it has been worked out in a commercially practicable way by M. E. Launbranch, an engineer of Chicago.



A message is made to flash on a sign very much as type is set up on a linotype machine. The operators punch the keys to spell it out

Compared with Electricity Gas Is Still the Cheaper Medium

IN spite of the decreased cost of electric service and the increased efficiency of electrically operated devices, the fact remains that of the two sources of energy generally available for heating, lighting and cooking, namely, electricity and gas, gas is by far the cheaper medium. At the present time one thousand electric heat units cost fourteen times as much as one thousand gas units. Furthermore, it is impossible to cook as rapidly with electric heating devices as with gas cookers. In the lighting field gas is, under certain conditions, cheaper than electricity, although it has not the large variety of applications that electricity has.

A Telephone Attachment Which Performs the Services of a Watch Dog

RUPERT H. GREENLAW, of New York, has invented a meter attachment which is a mechanical watch-dog for your telephone. It consists of a small case containing a locking and registering mechanism, a clamp which fastens it to the telephone standard, and a rod which engages with the telephone receiver. By removing the receiver the rod is forced in and out of the interior of the meter. It is impossible to replace the receiver upon the hook until the call has been registered.

The attachment which locks the telephone when it is not in use and registers all calls

A Silo Roof Which Opens Like an Umbrella

A ROOF built like an umbrella is the ingenious device of a manufacturer of appliances for silos. It has this advantage: the structure can be filled five or six feet above the level of the walls; as the ensilage gradually settles, the roof will close down upon it automatically. This eliminates the need of a second filling of the silo after settling, and saves a good deal of labor and time.

By pulling a rope one man can easily spread the umbrella roof

The silo roof is constructed of triangular sections of galvanized iron, which are joined by sections of tenting. When the roof is open it forms a continuation of the cylindrical walls of the silo, and as it settles upon the contents the triangles of metal join snugly. By an arrangement of joints that overlap, a weather-proof cover is formed. Within this are the sections of canvas, which are likewise protected from the elements.

The supports that hold the roof to the upper wall of the silo are of wrought iron, and are so narrow that they offer little resistance to the wind. By pulling on a rope suspended through the center of the structure down to the floor, a single man can open the umbrella.

The roof can be attached to silos of concrete, metal, wood or tile. It is made in diameters of eight to seventeen feet.

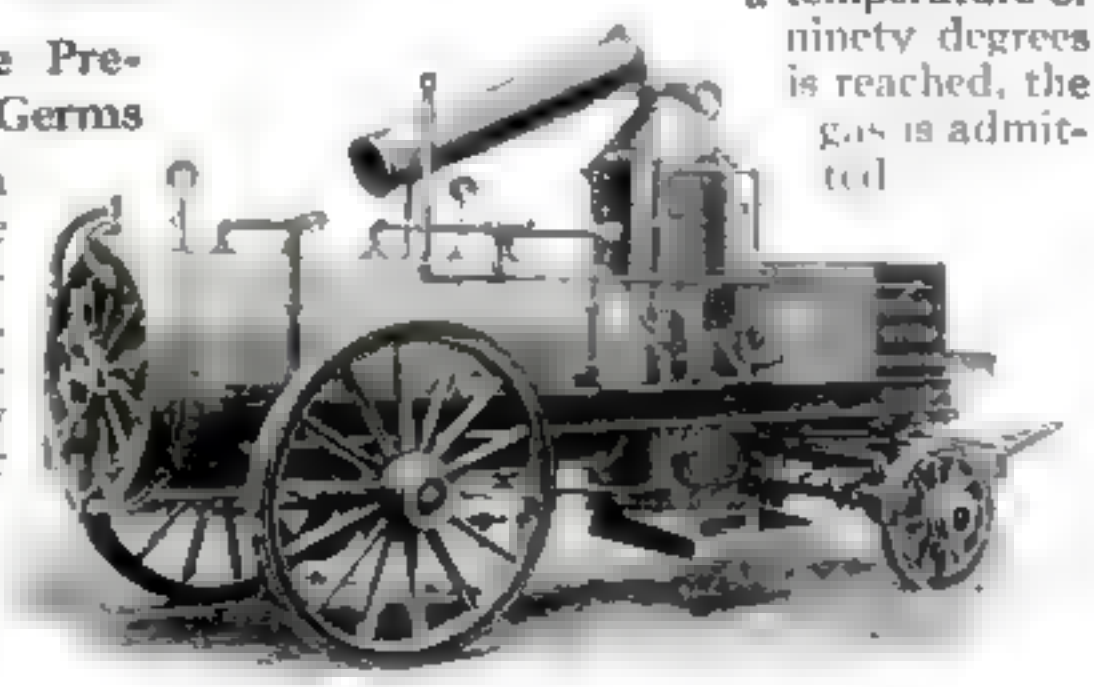
The United States Armies Are Preparing to Fight Vermin and Germs

CLOTHING disinfectors of a portable type similar to those in use in Europe have been purchased by the United States Army.

The outfit consists of a five-horsepower upright boiler connected by piping with a cylindrical chamber about six feet long and three feet in diameter. The rear end of this jacketed chamber is provided with a door that can be hermetically sealed. A rack for clothing slides into the chamber, while smaller articles are laid on a grating where they may be steam-soaked. The steam is generated in the boiler at about eighty pounds pressure. Suitable valves are provided to reduce this pressure to ten pounds when it enters the chamber. When the jacket about the chamber is thoroughly heated, the articles to be disinfected are placed in the rack, which is then pushed into the chamber. The door is closed and made steam tight. When the temperature within the chamber has risen sufficiently, an exhauster is opened until the gage shows about fifteen inches of vacuum. Then a small amount of steam is allowed to enter the chamber. Following this, the exhauster again is opened until fifteen inches of vacuum is indicated.

Steam is then allowed to enter the chamber until the temperature within it rises to two hundred and thirty-eight degrees F. The steam is allowed to circulate through the chamber during the period of exposure. It is then cut off, and the exhauster draws off steam and vapor. After a short drying period the door may be opened and the clothing removed.

When using formaldehyde gas as a disinfectant in the apparatus the jacket is brought to a temperature of eighty degrees F.; the clothing then is placed in the chamber and a vacuum of fifteen to twenty inches obtained. When a temperature of ninety degrees is reached, the gas is admitted



A disinfector for our Army. It can handle fifty uniforms and kits in forty minutes ridding them of all germs

Flushing Streets with Water Pipes on Trolley Cars

IN Worcester and Springfield, Mass., the day of horse-and-wagon street flushing is past. Trolley cars carrying large water-tanks and electric pumps have been found much more effective and considerably more rapid. The pumps force the water out in such powerful streams that the trolley-car method has proved itself cleaner than the horse-drawn barrel-wagon from which the water flowed by gravity.

The pump supplies water to four pipes. Two of these lead to nozzles on the car itself and two lead to an arm which swings on the road-side of the car. This arm is swung back when automobiles or other obstructions are to be passed.

The flushing is done early in the morning after the cars have first gone the rounds in sprinkling the streets. The cars run at high speed so that an entire city can be cleaned by a very few of them in a very short time. With the old horse-and-wagon method speed was impossible. Sometimes the sprinkling had to be started during the night.

The added expense of the electric pump is balanced by the saving in the number of units and of men, so that the running expense of the new method is not increased. On the other hand, only eighty-five per cent of the water formerly used is now required. The side streets which are not tracked are now flushed by connecting long hose to the street hydrants.

Electric motors pump the water in four powerful streams that wash away every trace of refuse while the car runs at high speed

Dr. L. L. Funk, using his mechanical broach wrapper and sterilizer. At no time during the process is the cotton touched by the hands

That Wad of Dental Cotton—Was It Sterilized?

IN cleaning the root-canals of affected teeth the dentist employs a wad of cotton wrapped on a steel needle. This wad is called a "broach," and is used in reaching the vital point where the nerve of the tooth passes out into the bony structure

Usually the dentist twists the cotton around the needle with his fingers, which is neither sanitary nor safe in most cases. Dr. L. L. Funk of Chicago has invented the machine shown in the illustration. It does the wrapping mechanically, and sterilizes the cotton at the same time. Different methods of sterilization are provided for. The first is by means of dry heat of 275 degrees Fahrenheit, obtained from the electric heating unit; the second employs steam obtained by placing a four-candlepower electric lamp in a glass water-container and bringing the water to boiling point. This is used for moist sterilization and for melting inlay wax. A carbolized sponge is used for sterilizing the needles.

Mountains That Float

Why? Because the underlying materials are lighter than the mountains

IN a remarkable series of researches conducted by the U. S. Coast and Geodetic Survey, under the direction, first of Professor John F. Hayford, and later of Mr. William Bowie, Chief of the Division of Geodesy, it has been conclusively proved that mountains and continents, and probably islands, float.

The earth is solid. How, then, can we say that the mountains float?

A hundred or even a thousand years are as a day in the geological calendar; and for such periods the movement of portions of the earth, under any forces which may act on them, would probably be so small as to go unnoticed. But when such forces act for a hundred thousand or a million years or longer, the earth's materials behave as if they were plastic; in other words, they give way to the forces affecting them, and assume a state of equilibrium. Those who work in the deep mines of the earth are familiar with the movement or creeping of the rock which will close old shafts or tunnels.

But what is the evidence that mountains float? The answer is in the observed tilting of the plumb line and in the measurements of the earth's pull, called gravity.

The Proof Furnished by Gravity

Let us confine our attention to gravity. If the earth's material were a perfect liquid, its surface would be perfectly smooth and the shape of this surface would be that of a ball. Since the earth spins very rapidly, centrifugal force is set up which causes the maximum at the equator and a minimum or zero at the poles. This means a shortening of the axis of rotation by a distance of about twenty-six miles. That is, the distance from the north pole to the south pole would be that much shorter than the distance through the earth's center between two points opposite each other on the equator.

Exartly the same shape would result if the earth's material, though solid, were arranged in layers according to the density, the densest material at the earth's center and the lightest at the surface. The earth would assume that shape because of the yielding under the attractive force of each particle of the earth's material on every other particle, and because of the centrifugal force due to the earth's rotation which tends to throw its materials out into space.

The resultant of these forces, or gravity, would on this ideal earth vary gradually in intensity from the equator to the poles.

How We Get the Idea of Floating

The earth's materials are not arranged in layers exactly with respect to their densities. As a matter of fact gravity determinations show that the materials under the vast plains along the coasts are arranged very nearly in the normal way, but that the materials under the mountains are found to be lighter than normal. The deficiency of material under a mountain down to a depth of about sixty miles below the sea level is almost exactly equal to the mountain material which is above sea level.

Similarly, under plateaus like those of our Western States, there is a deficiency of materials very nearly or exactly equal to the mass of material between the surface and the imaginary sea level surface beneath. The normal density is that under the coastal plains.

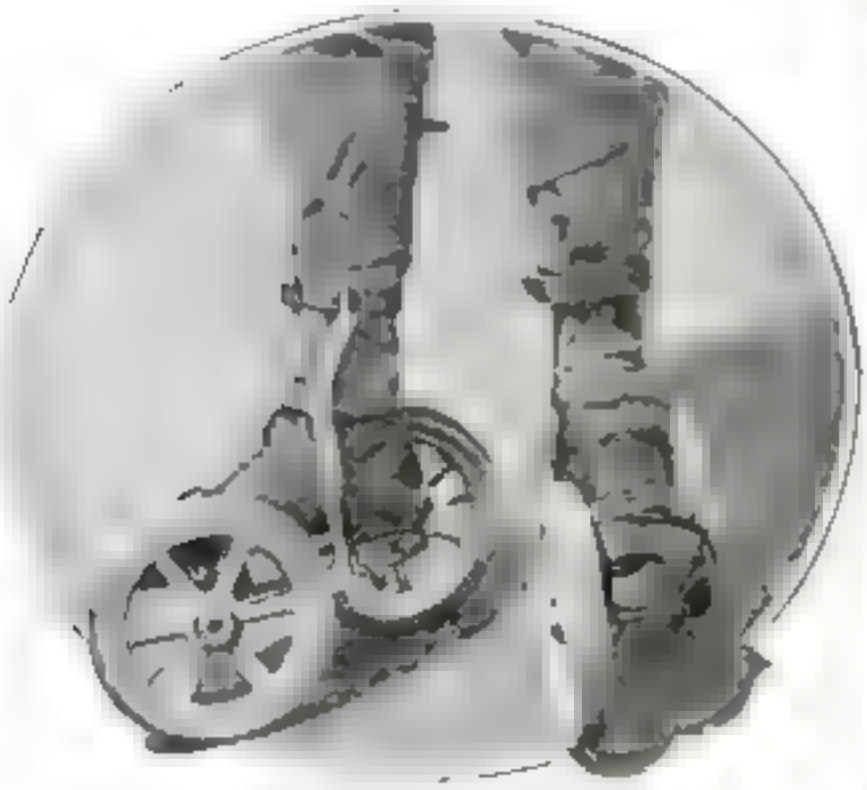
As a result of this counterbalancing of the material above sea level at any part of a continent by material lighter than normal under it, the pressure or weight of material on an imaginary surface about sixty miles below sea level is the same at all points of that surface.

This brings out the idea of floating. If we should see an iceberg floating in the ocean, we would conclude that the ice showing above the water is held up or floated as a consequence of a greater mass of ice under it. As all know, ice is lighter than water. A block of wood thrown in the water has some of its material held above the surface by the portion under the water. The weight of the material of the whole block exactly equals that of the water displaced by the block. Similarly the weight of a mountain mass and the column of material directly under it to a depth of say sixty miles, below the imaginary sea level surface, equals that of the weight of a similar column of material of equal cross section, under the coastal plain, which has little or no material above sea level.

Land Skates with Brakes and Pneumatic Tires

The latest "quicker than walking" form of exercise

A BALL-BEARING, pneumatic-tired skate which will run easier on a level road or street



The road skates are provided with brakes which are operated by the braces

than an ice skate will slide on ice, has been invented by Charles H. Clark, of New York city.

Located on opposite sides of each foot are two nine-inch wheels, the front wheel being on the inside of the foot and the rear wheel on the outside, so as not to interfere in any way with the movements of the legs.

On the outside of the leg, as shown in the illustration, is a brace journaled to the foot rest. The upper end of the brace is attached to the ankle, thus relieving it of any strain.

In addition to this purpose of protecting the ankle the brace acts as a brake arm to set the band brake on the rear wheel. By pushing either foot forward, in the same manner that a person would do who wanted to stop when walking, the brake is operated. The tires are resilient enough to enable the operator to steer with ease. According to the inventor a person equipped with the skates can travel three times as far with the same amount of effort as in walking.

Considering the skate as a foot-propelled vehicle it is certainly efficient. No transmission system with an attendant loss of power is necessary because the propelling force of the legs is applied direct. Furthermore, the skate need not be left at the curb like the automobile. Arrived at your destination you can unfasten your skates and take them into the building with you.

To travel, you simply raise one foot and then the other as you would in walking. The wheels are placed in such a way as to maintain an even balance at all times

The water is shallow and always warm. The rules of the sport are "Hold on tight and don't mind a ducking"

Rafting the Rapids on the Rio Grande in Jamaica, British West Indies

JAMAICA, although a tropical country, has a form of sport equal if not superior to tobogganing. The national pastime is shooting the rapids in the Rio Grande River on bamboo rafts. For about four miles of its length the river is one succession of rapids. The depth of these rapids is never over ten or twelve inches, and many of the rocks protrude above the surface, so it is not possible to use a boat at all.

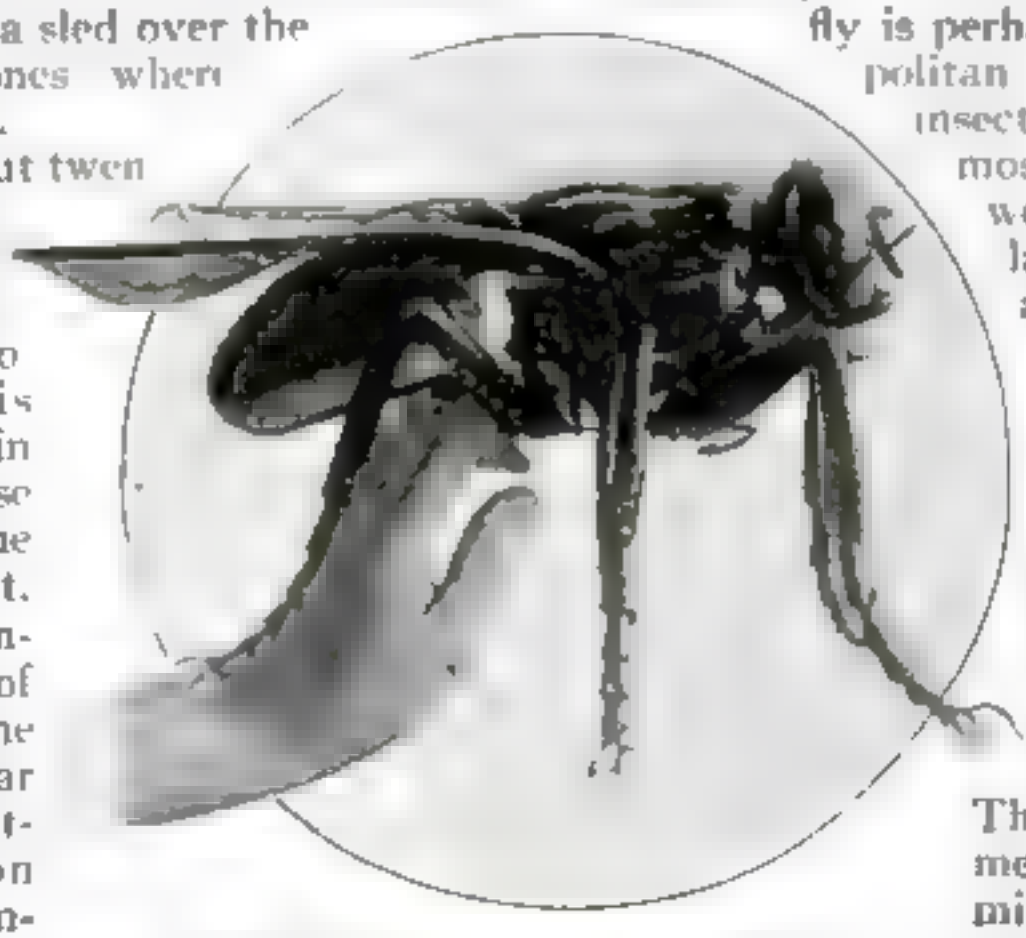
The natives build rafts of light, tough bamboo, which float where there is water and will slide like a sled over the wet, smooth stones when there is no water.

Each raft is about twenty-five feet long and is composed of twelve to fifteen stalks of bamboo The bamboo is about six inches in diameter at the base and tapers to one inch at the point. The tips of the bamboo form the bow of the raft and the base the stern. Near the stern is a built-up platform on which two passengers may sit and keep their feet out of the water, which often covers the raft. The helmsman stands towards the bow. With a long pole he guides the raft down the rapids and away from the worst stones.

Shooting the rapids is exciting Every cataract is different from its predecessor. One is short, another long; a third straight, and others are full of curves. We slide over the small stones that protrude slightly above the surface, but we must keep away from the large ones, for they will break up our frail raft, or, worse yet, turn it over on us. In some places jungle trees overhang the river so low as sometimes to sweep the passengers off; in other spots the channel between the high ledges is so narrow as to require very fine steering on the part of the negro helmsman. But it is seldom that a raft goes through without its passengers being thrown off, swept off or having their craft turn over on them.

Facts about Your Enemy, the Common Housefly

MORE than one-third of all the known flies belong to one family, Musca Domestica, or the common housefly. This fly is perhaps the most cosmopolitan in the whole order of insects, being found in almost every part of the world. The eggs are laid in groups, and in a few hours the larvae make their appearance.



A glass model of a housefly, magnified to show its interesting construction

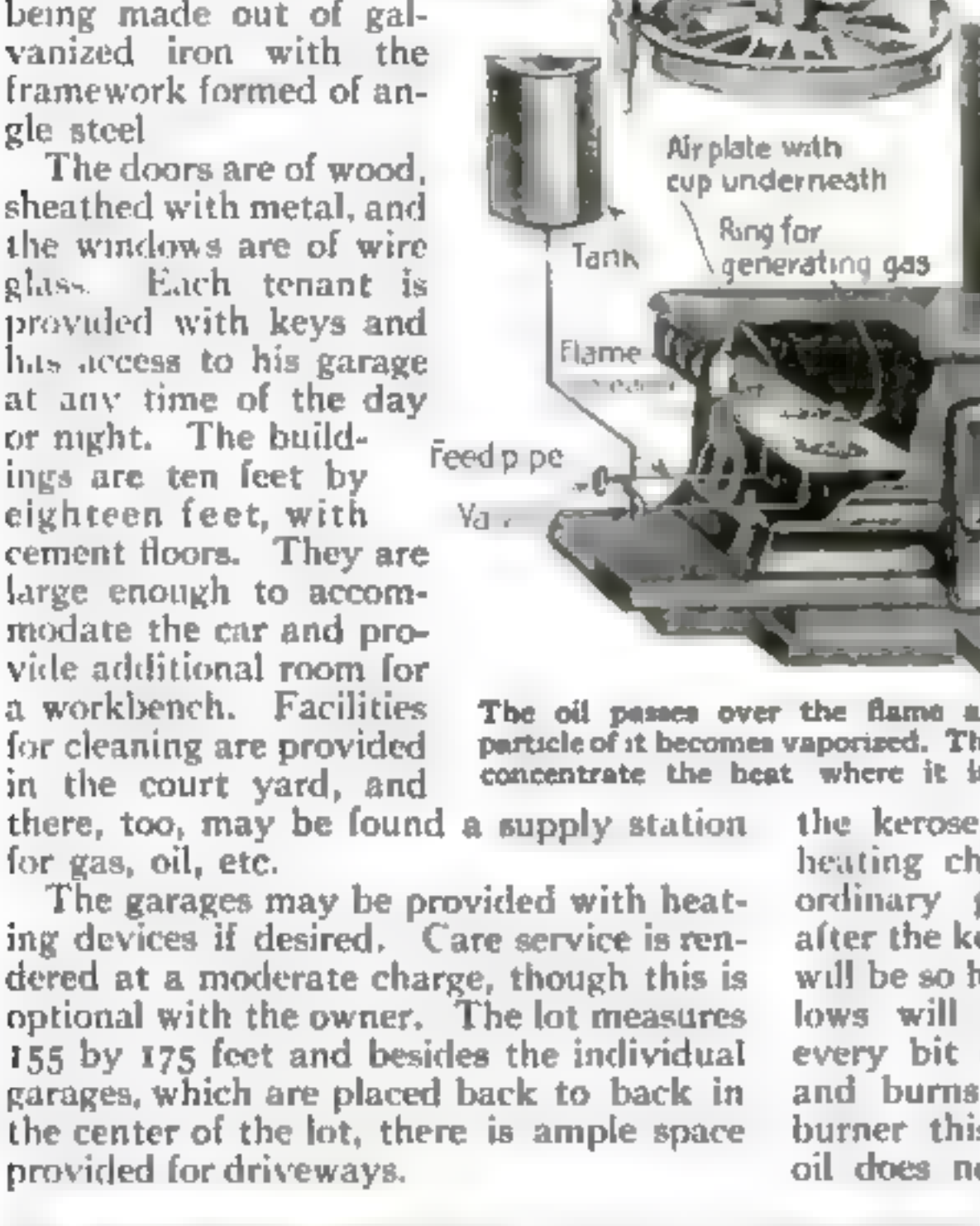
Each female lays about seventy eggs. Though the common housefly has been "swatted" all over the world, the fly family shows no signs of decreasing The most approved methods for its extermination employ prevention and sanitary measures.

A Community Garage Comprises Fifty Buildings on One Lot

FIFTY garages, set as closely together as possible, occupy a vacant lot in New York city. Each one is rented to a car owner living in the neighborhood. The fireproof structures are uniform in design, being made out of galvanized iron with the framework formed of angle steel

The doors are of wood, sheathed with metal, and the windows are of wire glass. Each tenant is provided with keys and has access to his garage at any time of the day or night. The buildings are ten feet by eighteen feet, with cement floors. They are large enough to accommodate the car and provide additional room for a workbench. Facilities for cleaning are provided in the court yard, and there, too, may be found a supply station for gas, oil, etc.

The garages may be provided with heating devices if desired. Care service is rendered at a moderate charge, though this is optional with the owner. The lot measures 155 by 175 feet and besides the individual garages, which are placed back to back in the center of the lot, there is ample space provided for driveways.



One city lot accommodates fifty buildings placed back to back, with room for driveways, as a community garage

Making the Kitchen Range One Hundred Per Cent Efficient

THE oil-burning stove of Garrtt Van Daam, a combustion engineer of Buffalo, New York, is a recently invented rival of the modern coal range.

The usual kerosene heater is a good little stove, but it is known to smoke and to smell generally. This shows that some perfectly good oil is being wasted. Van Daam's heater neither smokes nor smells, which means that it is practically one hundred per cent efficient. The coal stove is seldom better than fifty per cent efficient.

The oil passes over the flame and every particle of it becomes vaporized. The burners concentrate the heat where it is wanted

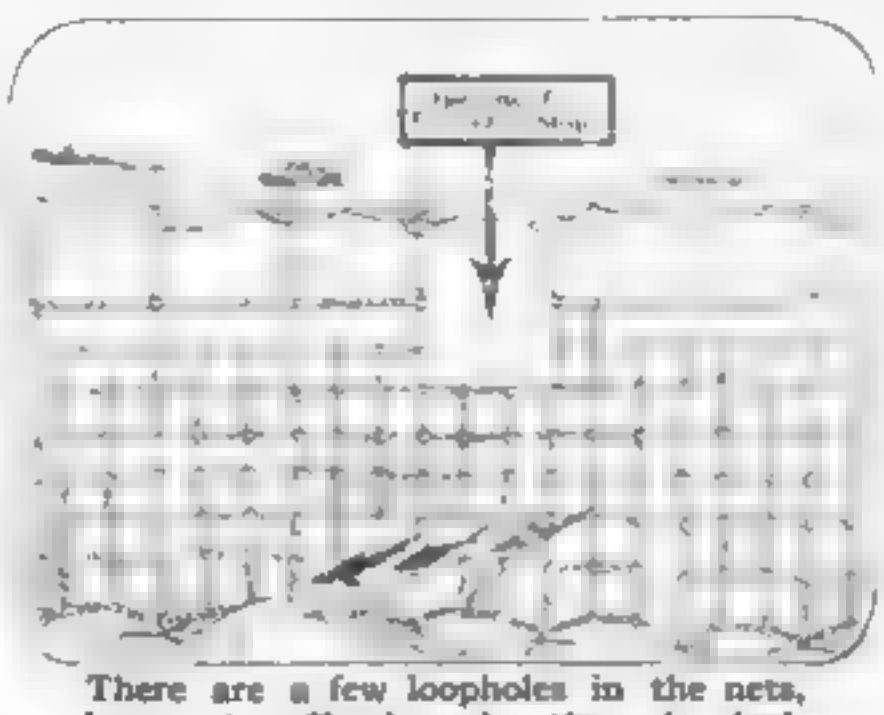
The secret of this burner's high efficiency is in the heating of the kerosene before it burns. From the supply tank near the stove, the kerosene feeds by gravity through a heating chamber placed directly over an ordinary gas-burner jet. Two minutes after the kerosene has been lit, the chamber will be so hot that all the kerosene that follows will be vaporized. In this state, every bit of the kerosene is combustible and burns fiercely. In the ordinary oil burner this is impossible because all the oil does not get the chance to vaporize. The portion that does not is wasted, because it merely changes into soot.

With the oil-burner made practical, there will be no more working in an overhot kitchen to accomplish a little cooking in the summer. The burners are placed to direct the heat only where it is wanted. For baking, the oven burner will concentrate the heat in the oven and neither the whole stove nor the room will need to be made hot along with it. Equally as comforting is the fact that the stove cools off immediately after the oil is turned off

Protecting the British Fleets with Chain-Nets

No enemy submarine can thread the English Channel without being caught like a fish in a seine

DISPATCHES from Europe tell repeatedly that hostile submarines have been caught in nets, but none of them have indicated how it was done. The English fleet is kept in the Orkney Islands, protected by great steel chains woven in the form of simple nets which are not stationary but mobile. If they were anchored so that they could not be moved there is little doubt but that the industrious German commanders would find some way of getting through occasionally.

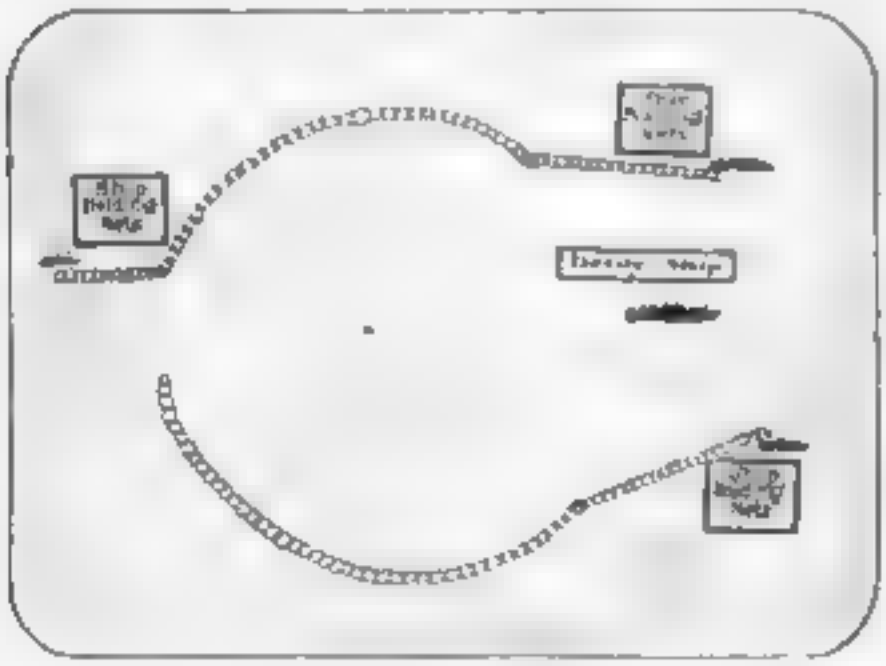


There are a few loopholes in the nets, known to officials only, through which commercial vessels may pass in safety

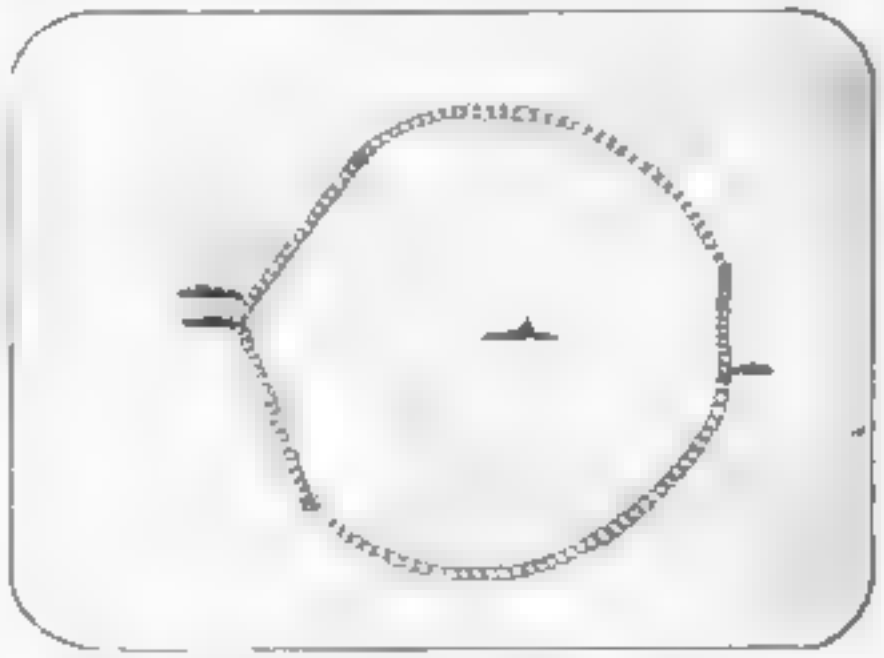
The nets covering the grand fleet are stretched out in great arms from the shores of the Islands, completely covering the fleet. Various types of enemy vessels have come steaming up to these barriers, though of course underwater, in the effort to catch the great fleet napping. Whenever a daring commander has attempted such a coup he has always, so far, found himself not only nosing against a network of great chains but when he turned to run he has found himself in a circular net and doomed

The British operations are simple. A sharp lookout, and probably electric lookouts as well, keep the chain operators informed as to what is going on. When an enemy submarine enters the net its presence is soon known and the operators, taking the ends of the chain, draw it together to form a circle. The trap is then sprung. The British wait until something happens until the submarine comes cautiously to the surface to look about, for there is nothing else that the commander can do. Once up he has the choice between destruction by shell or surrender, and to the credit of Germans it must be admitted that very often the commander refuses to surrender, hoping that some means of escape may still lie open.

The same sort of traps exist in the English Channel, where great chains are spread from the coast of France to the coast of England, with but a very few loopholes which are known to British officers only, through which commerce may be carried on in safety. Every time a raider or a submarine cargo boat slips out of Germany it takes the northern passage. The channel is impossible to negotiate for any uninformed ship captain and it probably

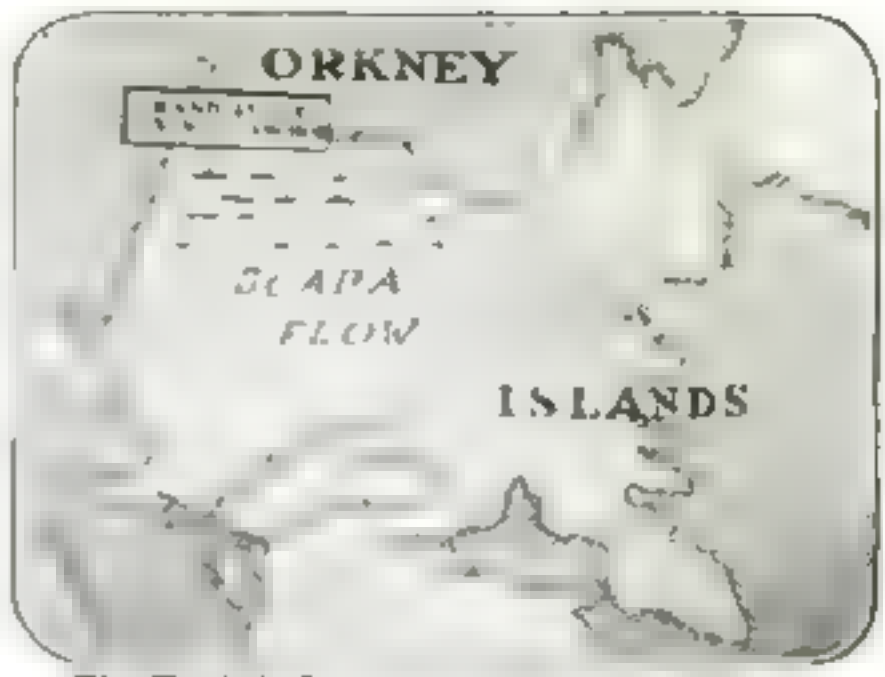


A decoy ship leads a pursuing submarine into a circle of nets which immediately close up around it so that there is no escape



Once enclosed by the chain of nets, the commander of the intruder faces destruction from the shells or complete surrender

The traps are spread from the coast of France clear across the English channel



The English fleet, anchored in the Orkney Islands, is completely protected by the nets

would still be so were the grand fleet in the Orkneys to be destroyed.

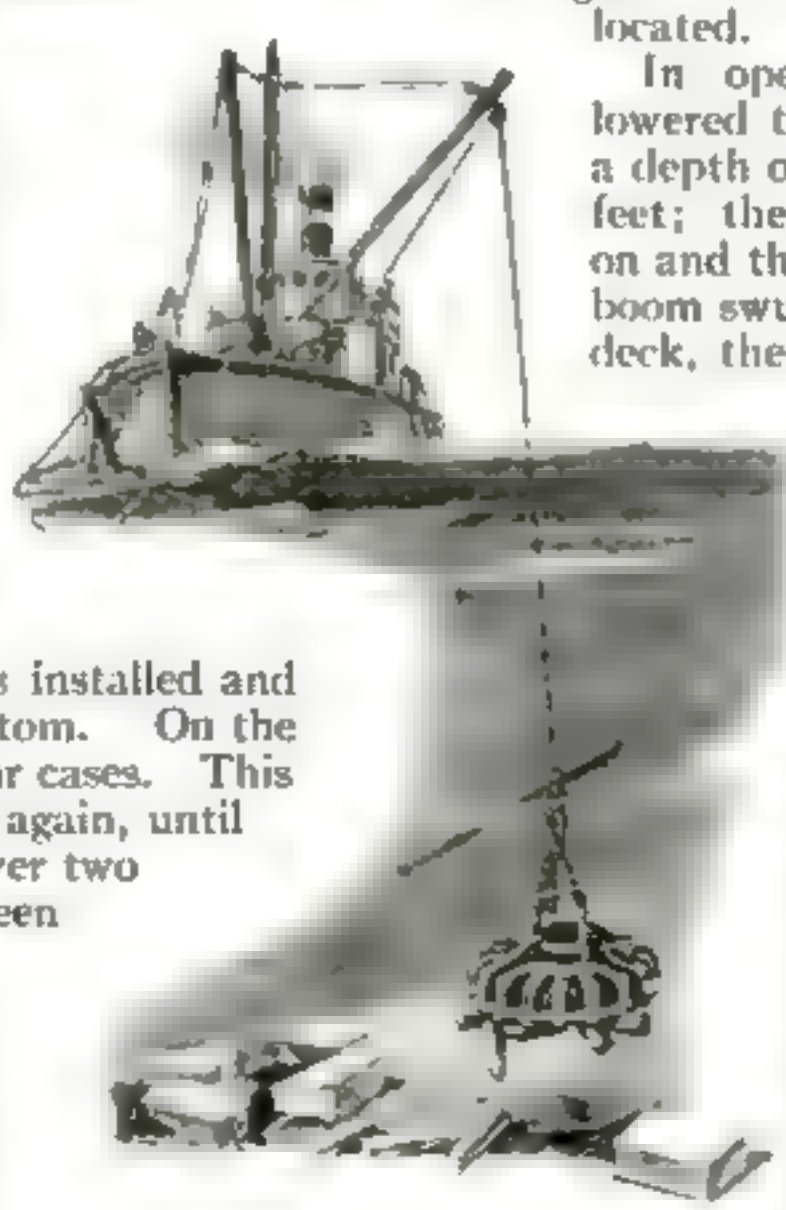
When United States Naval officers were consulted concerning the use of these nets, and the possibility of such a method they unanimously agreed that it was possible, although they knew nothing about it. They said that nets were certainly being used and that very probably the minor difficulties in their way had been solved.

The Latest Salvaging Device for Metals —An Electromagnet

A LIGHTER accidentally turned over at sea, spilling several thousand cases of shells. A diver was put on the job, but owing to the ice and extremely cold water, he was able to work only a few hours at a time. At the end of a day less than one hundred cases had been raised.

An electromagnet was installed and dropped to the river bottom. On the first trip it recovered four cases. This was repeated again and again, until at the end of the day over two hundred boxes had been brought to the surface.

A large number of cases were broken, so that the shells fell out and sank deep in the mud. This magnet was found powerful enough to draw both shells and cases out of the mud.



The electromagnet diver bringing to the surface cases of shells some of which were buried in mud

In fact when a shell is left at a distance of about twelve inches from the magnet and the current turned on, the shell, weighing about 255 pounds, jumps to the magnet.

The outfit consists of a gasoline-driven generator, control apparatus for the magnet, and the magnet, which weighs about 9,000 pounds, and requires from eighty to ninety amperes at 240 volts direct current to energize it.

The magnet was attached to the cable, and by means of a swinging boom could cover a large area without having to move the lighter on which the apparatus was located.

In operation, the magnet was lowered to the bottom of the river, a depth of between thirty and forty feet; then the current was turned on and the magnet lifted. Then the boom swung the magnet over to the deck, the current was switched off, and the cases of shells were dropped.

This type of magnet (designed for handling scrap iron and steel) though never intended to operate under water, is quickly attached and in this particular case was operated with marked success for ten consecutive days with no special attention or repairs except perfunctory tightening of the bolts and filling the main feed cables with tar. The cases of shells were recovered with comparative ease. The method will probably be used for other salvaging purposes.

Safety nets of rope are now taking the place of plank floors to insure the safety of those who work on skyscraper scaffolding

"Safety First" for Skyscraper Workers Attained with Nets of Rope

TO protect the men who erect the steel frames of skyscrapers, life nets are now used instead of the usual flooring. The building laws of practically every state require that the contractor install a plank floor for each story as the structural work progresses. In building auditoriums, arch trusses in theaters, towers, bridges and in special cases, it has sometimes been impossible to comply with the law, for plank floors could not be erected. Hence nets of rope were adopted as the most practicable measure of safety.

The nets are made of manila rope and are provided with loops on the borders so that they can be readily attached to the iron work. In Chicago they have been used for about a year. At least two lives have been saved with them. California has only recently adopted them. Ordinarily a net costs about sixty dollars, provided it is of the usual size—ten by thirty feet. The Illinois records show that workmen have fallen a hundred feet or more into a net without suffering any injury whatsoever. Had the men fallen on plank floors they would have been killed.

Seal Your Letters by Electricity

BESIDES its special task of keeping letters and packages intact and safe from prying eyes, sealing wax lends itself to many forms of decoration, especially on china. The chief difficulty in the way of its use is in heating it to the proper flowing state without smoking it or spoiling its color. A candle or small alcohol lamp is usually used, but the device shown in the accompanying illustration serves the purpose more satisfactorily.

It is the invention of Fay M. Andrews, of Columbus, Ohio. It consists of a hollow tube handle through which wires lead from an applying disk to conductors from the nearest electric lamp socket. A push-button near the applying disk controls a contact plate mounted in the handle to cut the resistance in or out. The applying disk is provided with a plug, like that of an ordinary small lamp, so that when it is screwed into the shell the proper electrical connection is made.

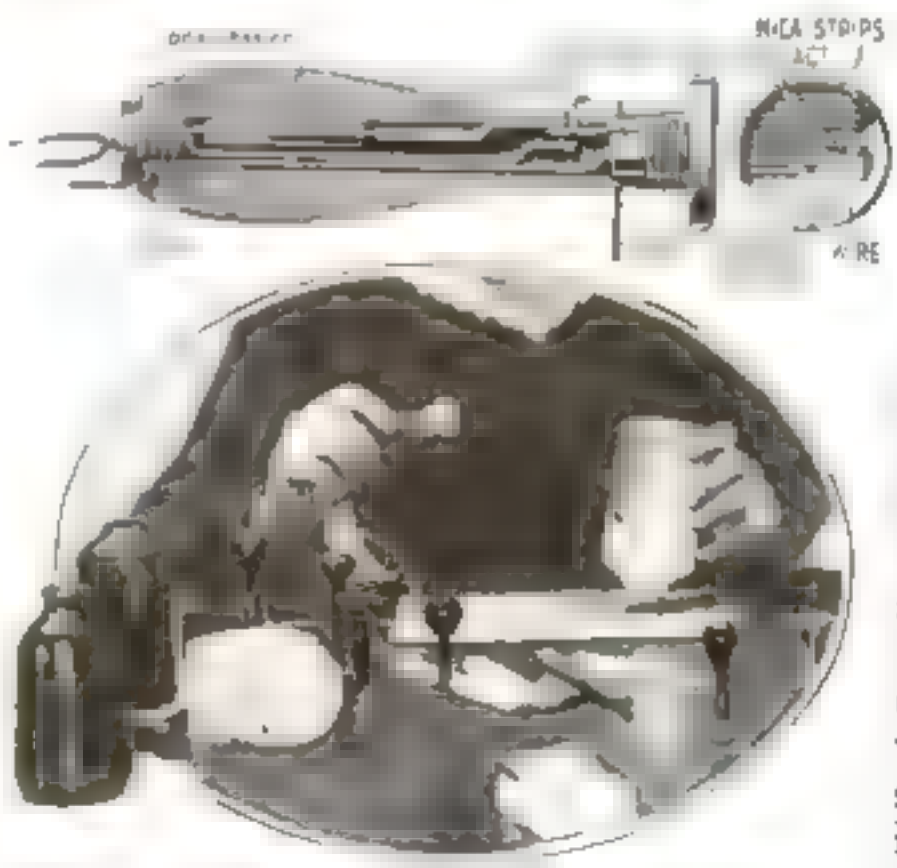
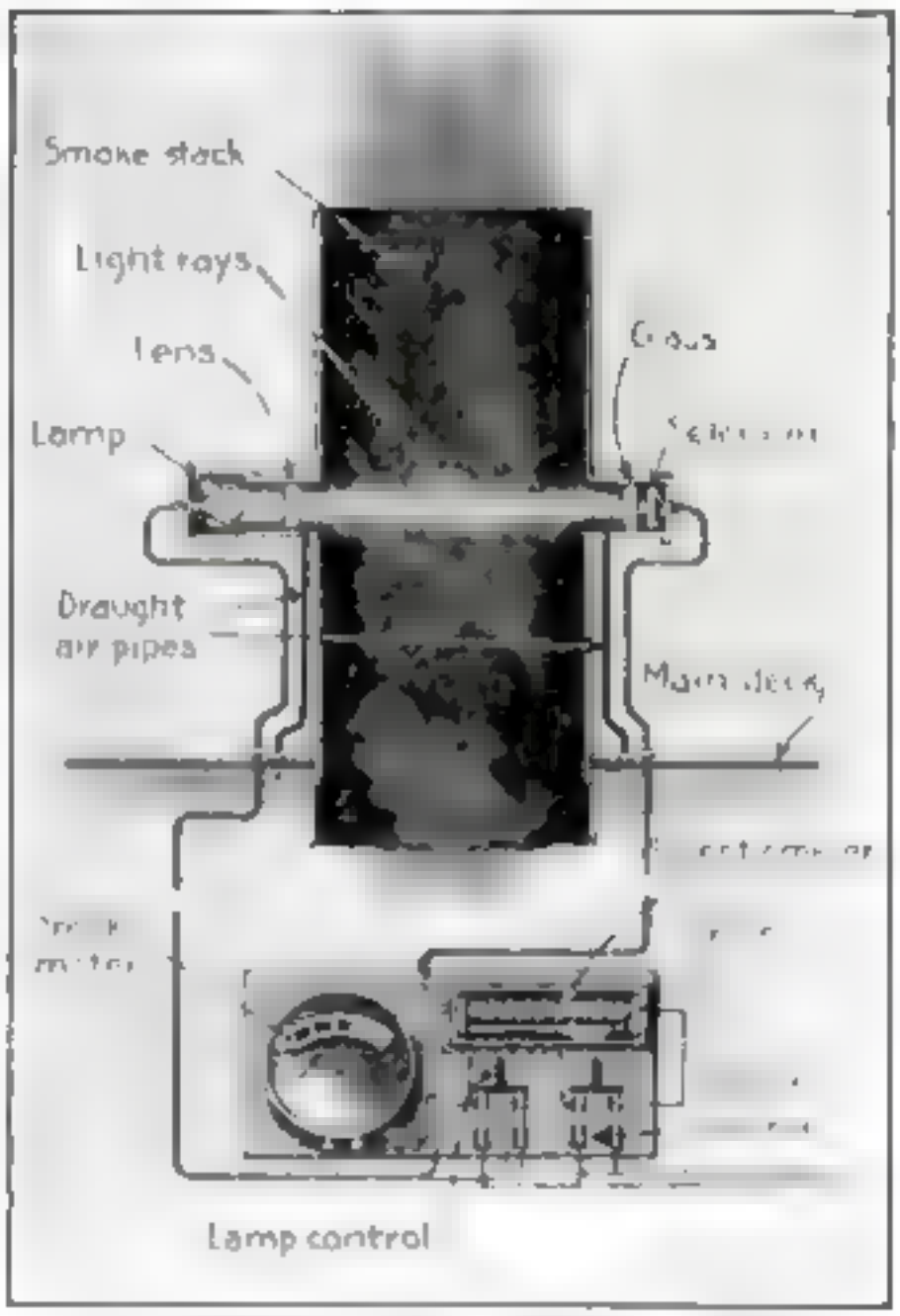


Diagram showing the construction of the electric wax-heater, and the device in operation

In operating it, the handle is gripped in one hand and the current turned on. The wax, which is held in the other hand, is then melted by the heat from the disk and dropped into place. The disk is then moved lightly to and fro over the wax until it is smooth, directing the flow wherever it is desired. It heats almost instantaneously with the pressure on the push-button.

An Electric Eye Watches the Smoke Screen During a Battle

THE manner in which the density of the smoke screens is now regulated during a battle is interesting. By partially shutting off the draft to her boilers, a battleship is made to emit clouds of smoke which screen her from the enemy. But how can the stokers, who are far below deck, see the stacks so that they can regulate the smoke clouds to the proper density? Answer—By an electric "eye." The eye is placed near the top of the smokestack and it records the exact density on electric meters conveniently located in the boiler room.



The selenium cell is sensitive to light. Hence when the smoke shuts off the light it can "see" what happens in the stack

This remarkably clever eye is simply a wire coil of selenium which is carried in a housing on the inside of the smokestack walls. An electric light, in another housing directly opposite, plays its beam of light squarely upon the wire. Now selenium, as is well known, has the peculiar property of changing its resistance to an electric current when the light falling upon it changes. The weaker the light, the greater the resistance, and vice versa.

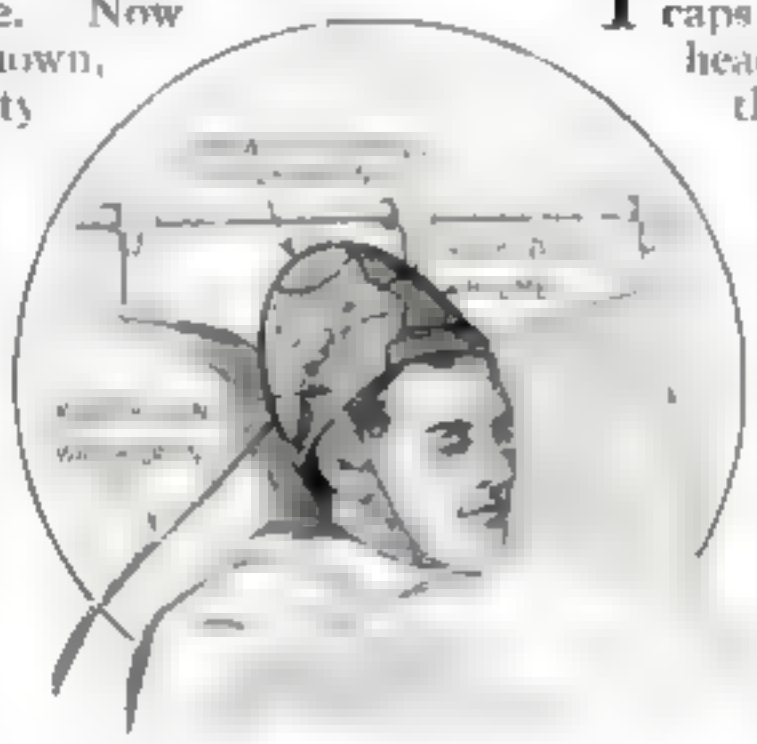
Evidently then, the denser the smoke emitted through the stack, the weaker the light that gets through the smoke from the electric lamp and falls upon the selenium. By connecting the selenium with an electric meter and the ship's lighting mains, the electric current going through the meter will be lowered by the increased resistance. The meter is very sensitive and shows the slightest change in smoke density. Moreover, it is calibrated to indicate exactly what the actual smoke density is, so that the stokers can regulate the cut-off of the draft to a nicety.

Glass plates are placed in front of the lamp and of the selenium coil to protect them from soot. The plates are kept clean by streams of compressed air directed across them. This device was installed on the U.S.S. *Conyngham* and was called to the attention of the Society of Naval Architects and Marine Engineers by Rear Admiral R. T. Hall, U. S. N.

An Ice Helmet to Relieve the Fever Patient Without Disturbing Him

THE principal defects of the ice caps so frequently used on the heads of fever patients are that they do not fit the head, they can not be refilled with cracked ice without removing them from the patient and the water can not be drained off.

A New York city inventor, M. Finkelstein, seems to have overcome all these shortcomings in devising the ice cap illustrated. A screw-top opening permits the nurse to replenish the cap with cracked ice without disturbing the patient, and a drain pipe is provided.



The ice helmet which can be drained and refilled without disturbing the patient. It fits the head securely

Practical Motor-Boating

A series of three articles on the selection, operation, care and upkeep of a motor-boat

I.—Selection of a Boat

By George M. Petersen

No doubt the best type of motor boat for large bodies of water is the raised deck cruiser, which can be navigated through almost any storm with little or no danger

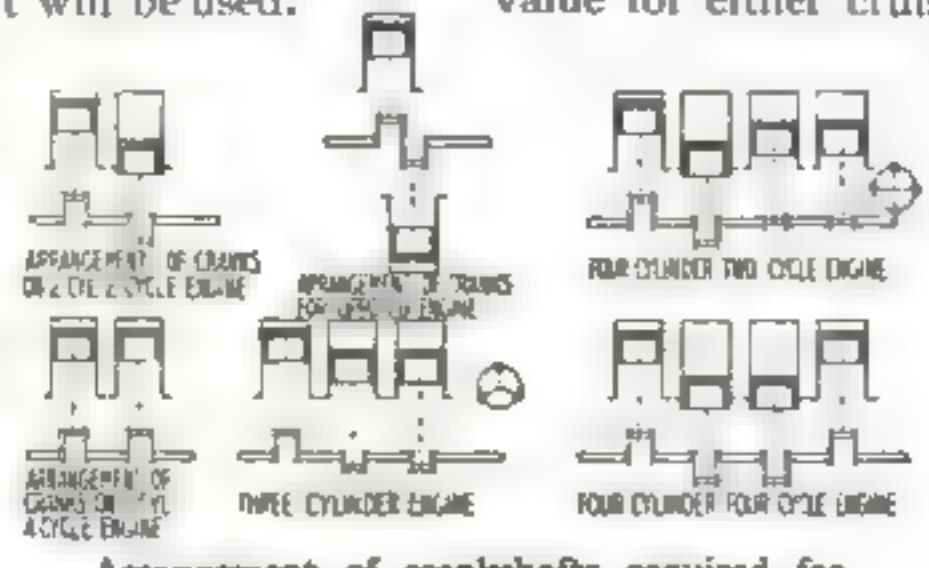
MOTOR-BOATING, as commonly thought of by the amateur boatman, consists mainly of trying to drive any kind of hull through all kinds of water, at any speed possible, by means of a mass of cast iron in the shape of a propeller in the stern of the boat. The old sailors are inclined to think of the motor-boat as the "dude's friend," which requires no knowledge of seamanship. While motor-boating is considerably easier to master than is the art of sailing a craft through all conditions of wind and water, there is, nevertheless, a knack to be acquired and mechanical knowledge to be obtained concerning it.

In this series of articles we will deal, first, with the classification of boat models for various waters, selection of the boat, and most desirable type of engine. The most important point is the selection of the type of hull best suited to the requirements of the waters on which it will be used. For instance, a glass cabin cruiser, while affording a large amount of head room and permitting an unobstructed view from within, is not to be considered as even a fair type of boat for large or rough bodies of water; but it is a desirable type of boat for rivers and quiet bays or other protected waters.

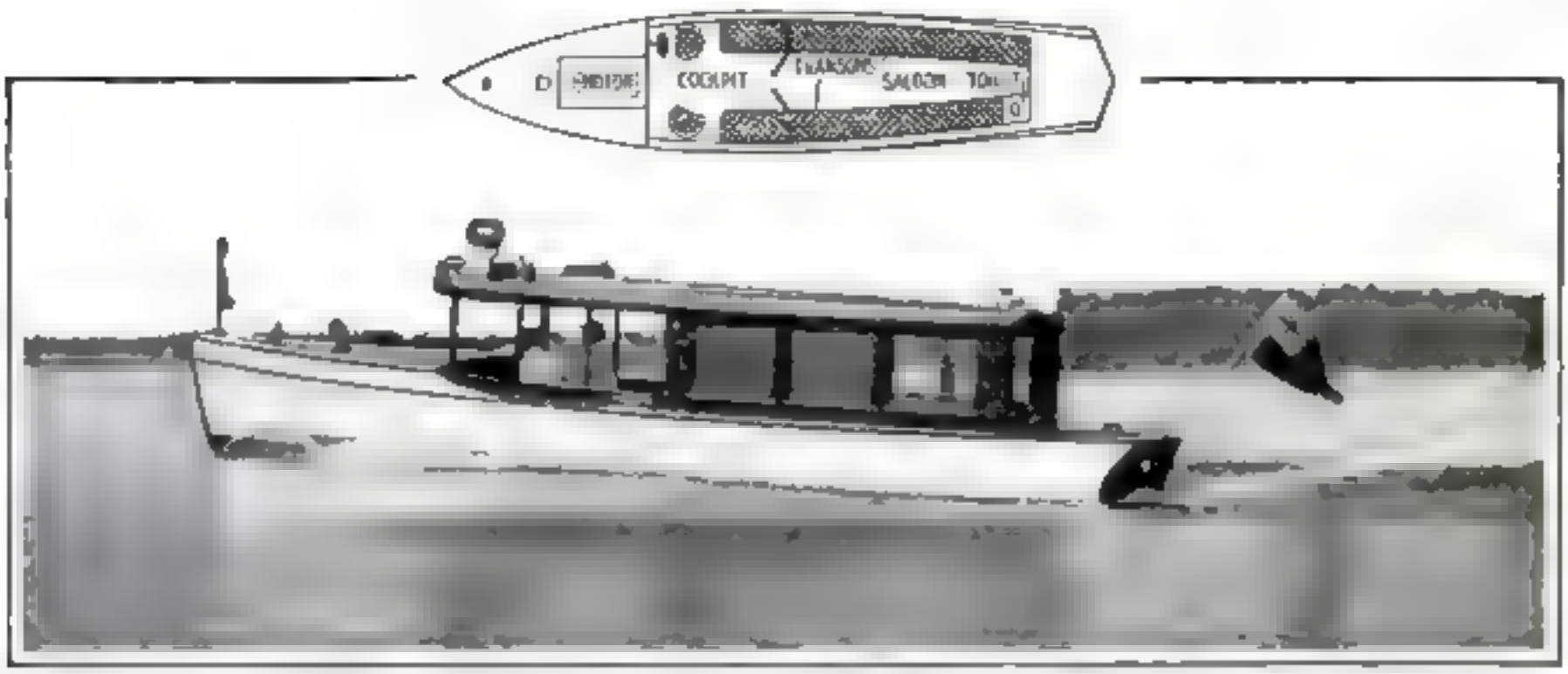
The best type of motor-boat for large bodies of water like the Great Lakes is undoubtedly the "raised deck" cruiser, which may be successfully navigated through almost any storm with little or no danger. This type of boat is generally built from twenty-six to thirty-five feet in length; the 27-foot model provides comfortable cruising accommodations for two or three persons. When equipped with a ten- or twelve-horsepower engine it is capable of a cruising speed of from eight to ten miles an hour.

Authorities differ greatly as to the most desirable type of boat for general use, but practically all experienced boatmen agree that some type of cruiser is the most satisfactory.

The long and narrow speed craft which delights the eye as it dashes past the Club House on a quiet day, is of absolutely no value for either cruising or long day runs on unprotected waters, as the excessive speed causes them to be extremely cranky and hard to handle in a seaway, and a quick turn is liable to cause them to capsize. However, for pleasure and safety the boat making from seven to twelve miles per



Arrangement of crankshafts required for different types of engines for motor-boats



For short trips and pleasure rides in protected waters the day cruiser is the most desirable of all boats, as it can be handled readily and will travel at a fair speed under favorable conditions

hour is the safest and most satisfactory.

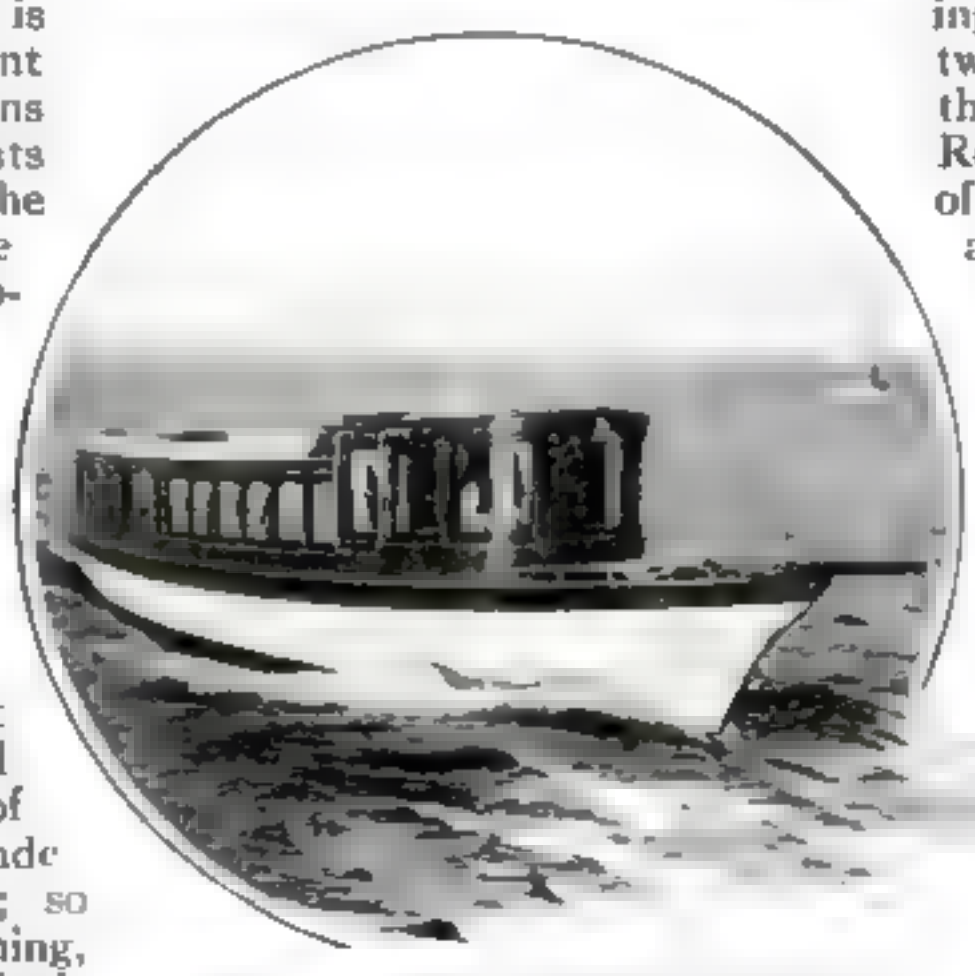
There are three ways of obtaining a motor-boat; the first is to have a boat designed to order by an experienced naval architect in which all of the whims and fancies of the owner may be incorporated. The second is to purchase what is termed a "stock model"; the third is to pick up a second-hand boat for a small sum and put it into condition. For the man who can afford the service of a naval architect, this article will be of little interest, but for the man who must select a stock model craft, or who is willing to experiment for two or three seasons with second-hand boats until he is sure of the exact kind of boat he desires, it will be helpful.

As quantity production greatly reduces the cost of any class of goods, the cost of the stock model motor-boat is relatively low. This is due to the fact that a certain plan is used for a large number of boats which are all made up at the same time; so the cost of designing, patterns, labor and incidentals is not charged up against one particular boat but against a large number. A few years ago the number of stock models which it was possible to obtain was limited, but on account of the great popularity of motor-boating recently there is now scarcely any model which cannot be termed "stock."

The "second-hand boat" method is the one which is undoubtedly the most satisfactory in the end. Some of these boats only need new hulls; the power plant is usually in good condition. At the present time boats ranging from twenty to twenty-six feet are the most popular. Real bargains in boats of this size are comparatively scarce, but as we go into the class of the thirty-five and forty-footers, the bargains are more frequent.

The most vital point of a motor-boat is always the hull, below the water line and near the keel. The condition of the timber may be readily determined by jabbing the

Deck plan of the neat glass cabin cruiser shown in the photograph below



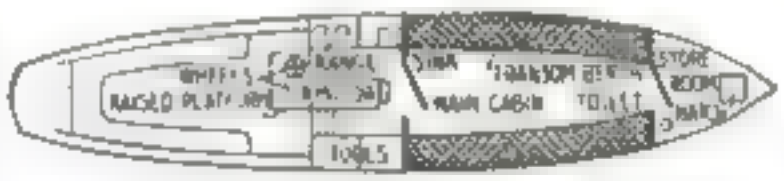
A glass cabin cruiser affords plenty of head room and is adapted for rivers

A bridge deck cruiser having two compartments is not considered a fair type of boat for large or rough waters but is adapted for protected waters, such as a lake, river or bay and for fair weather

planking with a sharp-pointed knife. If the timber is sound, it will be difficult to make the point enter the wood, but if it is inclined to "dry rot," the blade of the knife will sink into the plank, meeting practically no resistance. While this inclination towards rot does not necessarily condemn the boat, it does necessitate new planking or timber, and this expense must be figured when making an offer for the craft. There is an old idea held by many boatmen that the most vulnerable part of the hull is that which lies between "wind and water." This, however, is not the case. Dry rot is caused in most cases by steam. For that reason the bilge of the boat is most likely to be the part affected, as there is always more or less water lying in the bilge and the hot sun often causes it to steam.

The ribs should also be carefully examined. If they are spliced out or doubled it is a pretty sure indication that the boat is either getting pretty old or has at some time run ashore and been wrecked. As a general rule, a hull that has been re-ribbed or stiffened should either be inspected by an experienced boat-builder or be rejected entirely, for fear of its opening up badly in a pounding sea.

Authorities differ as to the most desirable power plant; but it is the model of the hull rather than the power used to drive it that develops the speed. For instance, the short, beamy, heavy fishing boats used on the Columbia River are equipped with an eight horsepower, single cylinder engine which drives them along at a speed of about six miles an hour. Several years ago the writer endeavored to speed up one of these boats by installing a twenty horsepower engine. This resulted in an increased speed of about one mile an hour, and the boat was practically wrecked from the excessive vibration and her sea-worthiness decreased to a large extent by the excessive weight. This same idea holds good in practically any class of craft.



Deck plan of the sturdy trunk cabin cruiser shown below

Separating Russian Prisoners from Vermin

The Germans have special stations on the Eastern frontier for "de-licing" friends or foes from Russia

GERMANY is more afraid of vermin than of machine guns. To the German military surgeon a filthy Russian Cossack—and there is nothing filthier—is more to be dreaded than screaming shrapnel.

Germany, in particular, has to deal with the problem in a serious way. Thousands of Russian prisoners of war have been brought into German concentration camps literally swarming with lice. One of the accompanying photographs shows four Russian prisoners as they arrived at a camp. Their caps of fur, their whiskers, and their heavy clothes were veritable breeding places for vermin of all kinds. The men were not long in the camp, however, before these caps were discarded, the whiskers and the hair removed, and new clothes supplied. Then they appeared as in the right-hand photograph below.

One of the disinfecting stations at which the Cossacks are deprived of their fur caps, coats, whiskers and vermin

Every man, nobleman or commoner, friend or foe, who enters Germany from Russia must be "de-liced." There are special stations along the eastern frontier for that purpose. Even royalty is not spared. Prince Adelbert, one of the Emperor's sons, had to be thoroughly disinfected and purified, not because he needed it, but because it was the military law. He received a guardedly phrased certificate to the effect that "His Royal Highness, Prince Adelbert, is, for the time being, free from lice." The military disinfectors were not guaranteeing the future.

Provision is made in all armies for the extermination of bacteria-carrying insects. All men occupying the same quarters at the same time, or for alternating short periods of time, are regarded as a single unit and are transferred to a receiving station equipped with cleansing apparatus.

Photos © Brown and Dawson

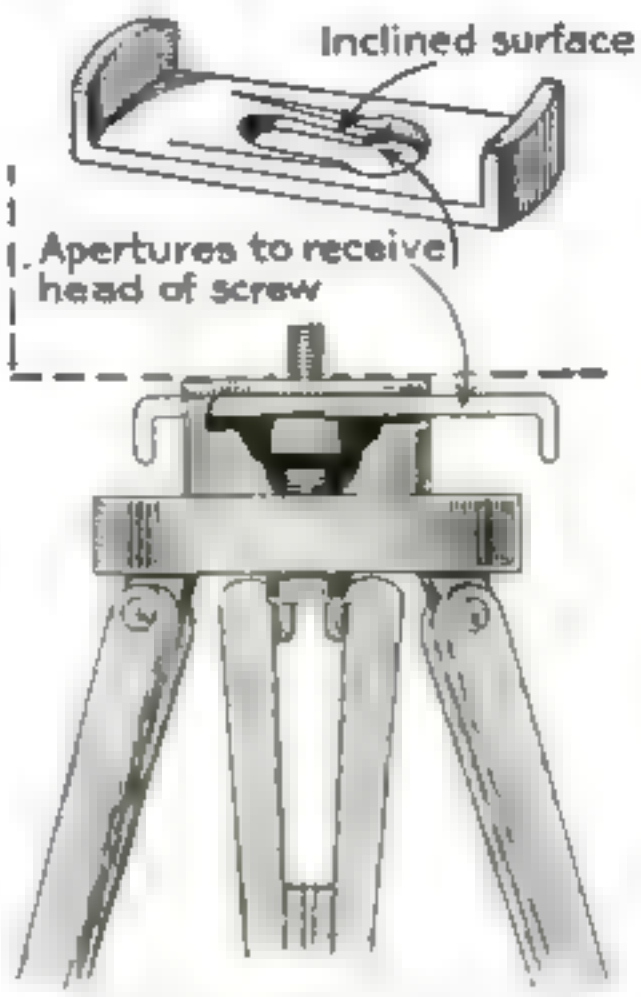
This is a "Before and After" photograph. At left four Russians are shown as they appeared when first taken prisoners. They came out of the de-licing station cleaner if not happier men

An Attachment Which Will Lock Your Camera to the Tripod in an Instant

AN ingenious camera attachment has been invented by Clarence J. Dawson, of Detroit, which will instantly lock your camera to its tripod, and will just as quickly release it. It does away with the inconvenience of having to turn your camera a dozen times about the tripod stand in order to screw it down tight. With this attachment, the camera can be locked down by the mere pressing in of a bar, when pointing in any direction.

One-half of the attachment consists of a metal casing which is screwed permanently on the tripod stand. A slotted locking bar slides back and forward just beneath the top of this casing. The other half of the attachment consists merely of a metal disk through which a flat-head screw projects to within one eighth of an inch from its end. This half is screwed into the threaded aperture in the bottom of the camera. The camera is immediately ready to be locked to the tripod. This is accomplished by setting the camera down so that the flat-headed screw passes through the hole in the top of the metal casing, and through the hole in the locking bar, also. The bar is pressed inward. The wedge-shaped slot in the bar grips down upon the head of the screw, fastening down the camera in the operation.

Simple it surely is, and it can be made very cheaply. Automatic pressing machines could stamp the parts from sheet steel.



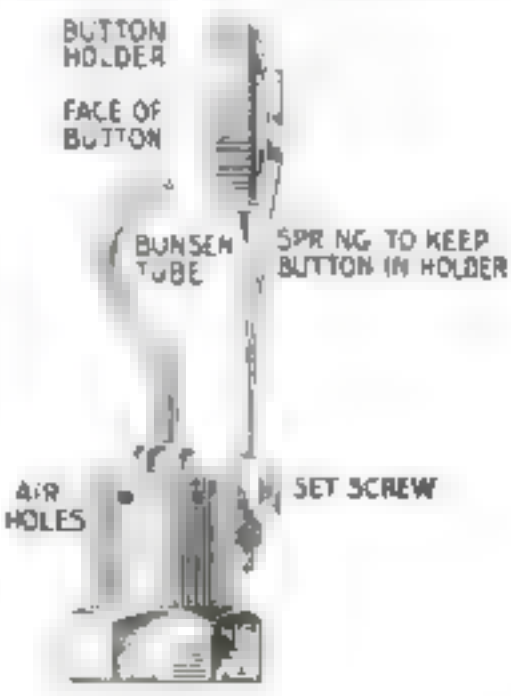
A flat-head screw is passed through the top of the casing and the hole in the slotted bar to the bottom of the camera

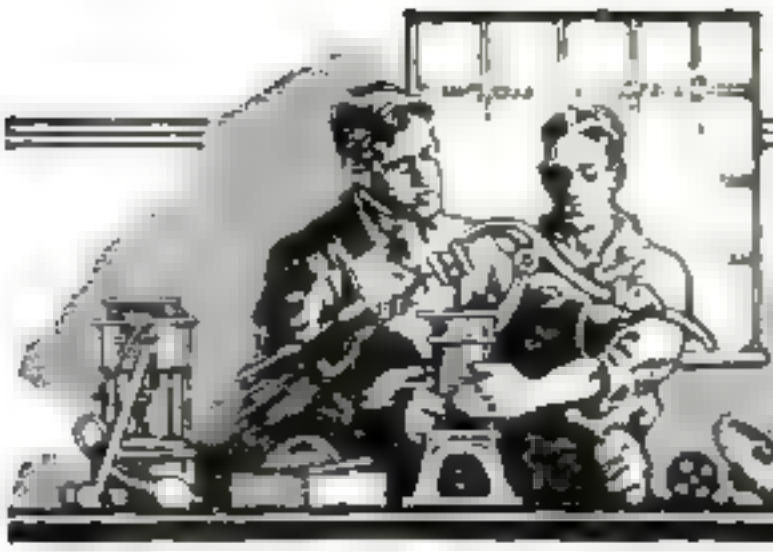
Making the Acetylene Light as Brilliant as the Electric Lamp

THE accompanying diagram shows the details of an ingenious device which makes the acetylene light almost as brilliant as that cast by the electric lamp on automobiles and motorcycles. The burner consists of a round disk, or "button," three-fourths of an inch in diameter, set in a pressed metal holder. It is made of the same white substance of which ordinary gas mantles are constructed. A tiny bunsen burner directs the flame against this disk, which is thus caused to give out a bright incandescent light. The burner is designed to fit any standard headlight from an acetylene tank.

Two kinds of light may be produced. If the white disk and bunsen tube are pointed toward the reflector, a brilliant white light is thrown far ahead on the pathway. If the burner is turned so that the flame comes from the front, a diffused light is cast instead of the powerful ray. This is really equivalent to a dimmer, since it is a light which does not dazzle. No wrench or other tool is required for turning the burner. It can be easily accomplished with the fingers.

Here the light is directed into the tree top. At right is a diagram of the burner





FOR PRACTICAL WORKERS

Cutting Clippings from Magazines with a Pin

WHEN you lose your knife or do not have a pair of scissors at hand for cutting the paper a common pin or needle of any kind serves the purpose admirably. If it is a single sheet from which the clipping is to be removed, lay the part on another paper, hold the pin slantwise so that the point will follow around the clipping, just as if tracing its outline. Pass back over the scratch with the point in the lead and you will be surprised how smoothly the pin cuts the paper. This method can be used to good advantage by the housekeeper for cutting paper that requires a fairly straight line.—L. MURBACH.

Solid Board Fence with Artistic Upper Edge

THE owner of a small cottage wanted a garden in his back yard, and to prevent prowlers running over it at night it was necessary to have a high wall or tight board fence. To secure an artistic effect the fence was made as shown in the illustration. The scalloped edge effect was obtained by using boards 10 or 12 in. wide of 4 ft. 8 in. and 5 ft. lengths placed alternately. The difference in the lengths of the boards is such that the depth of the opening is less than the width, making a rectangular form of a cut-out or scallop. The boxes are also spaced evenly and fastened on the ends of the longer boards. They are square, slightly smaller at the bottom than the top, with their height about equal to the depth of the scallop. Four sharp-pointed ornamental side pieces were nailed on the boxes as shown, which aid in bringing out the low

Ornamented square box on the fence corner

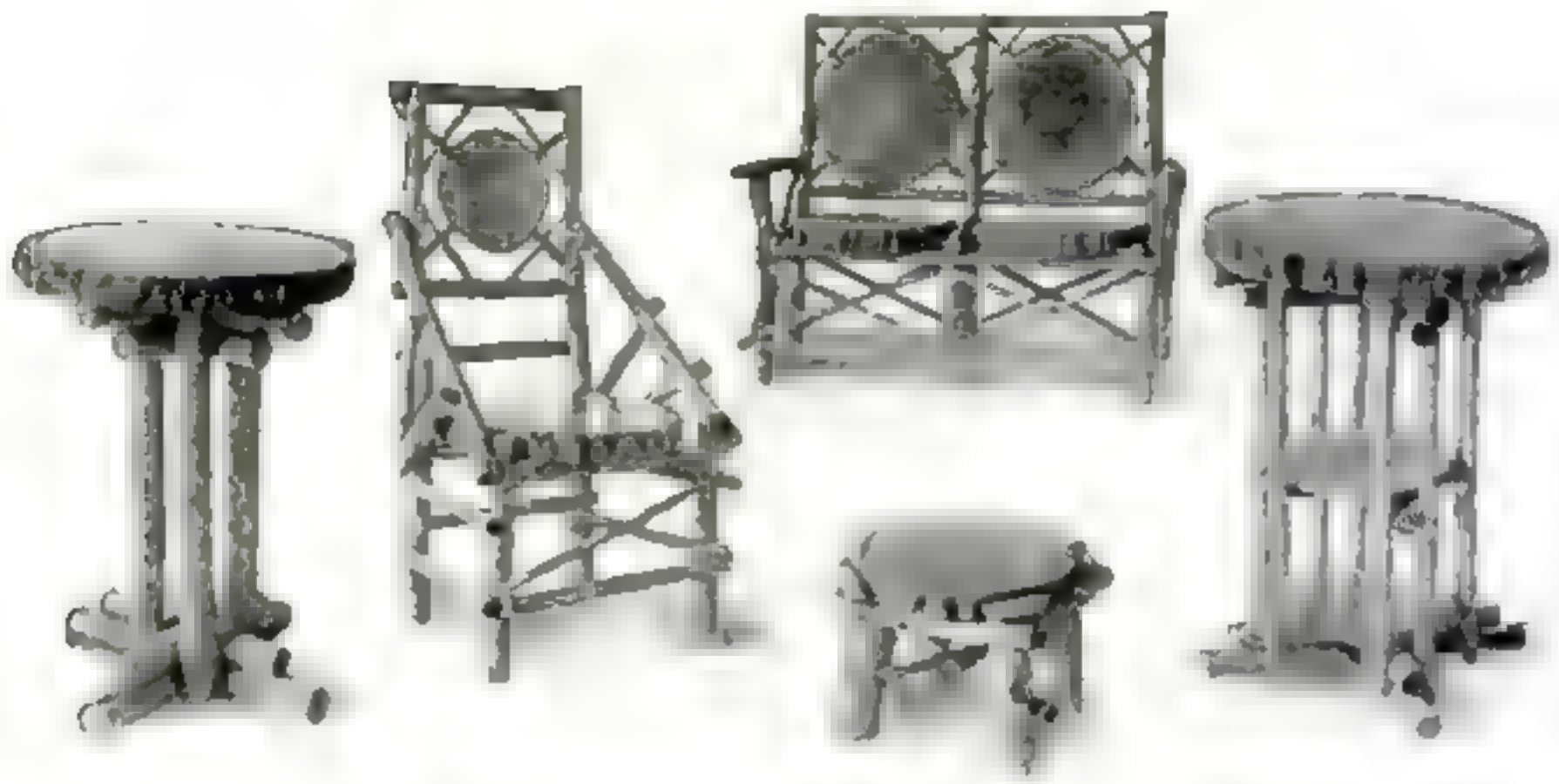
A part of the solid board ornamental fence surrounding a corner of the rear garden

form idea. The flowers grown in these boxes are bright colored and decorative.

Within the inclosure the ground was artistically plotted, and laid out with gravel paths having wood edges. All boards were painted with whitewash or exterior water paint.—L. R. PERRY.

Rustic Furniture Made of Poles and Logs

THE illustrations on the next page show a new idea in rustic furniture. Almost any kind of wood may be used; however, these are small tamarack poles and disks sawed from an oak tree. These disks, when made very smooth by planing and sandpapering, and then given a coat of oil and one or two coats of spar varnish, present a very fine appearance, showing the grain to the heart of the tree. The completed furniture is comfortable and handsome enough for use anywhere. Some of it is heavy, however, and when used inside, whether on a porch or in a living-room, should be fitted with casters.



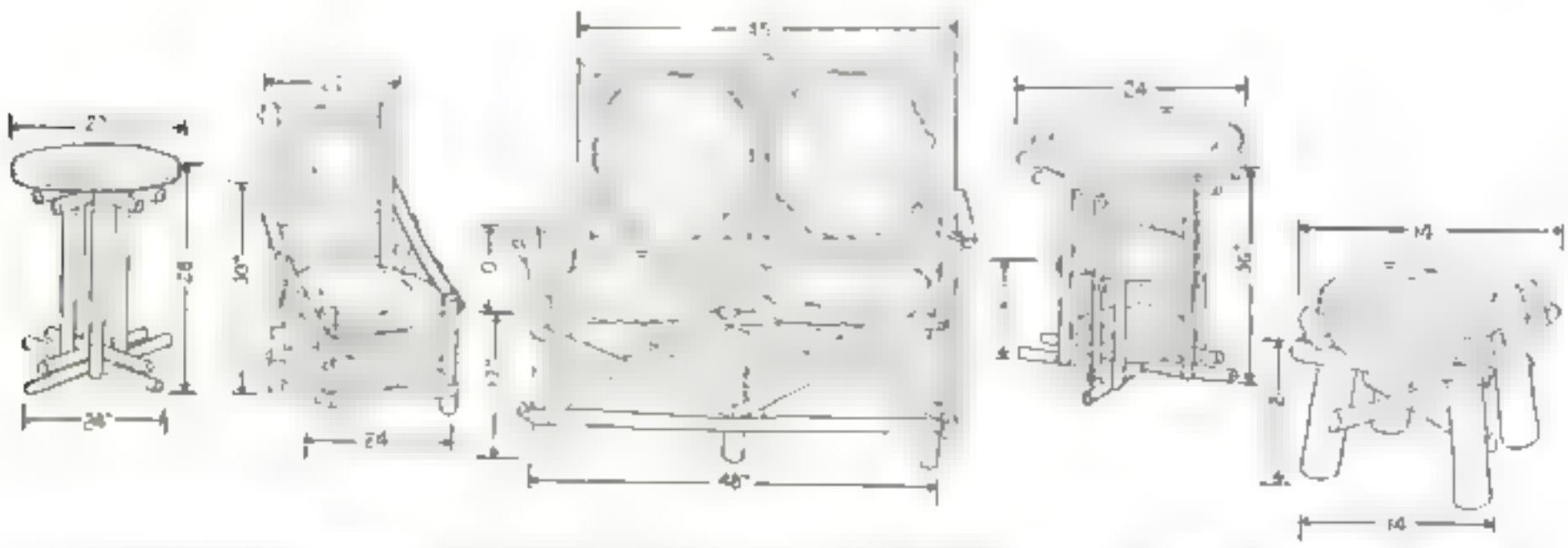
The larger portions of each piece of furniture consist of disks of wood sawed from a large tree trunk, the other parts being made up of tamarack poles with their ends smoothed and oiled

No mortising, as in ordinary furniture making, is needed. The lapping of one piece over the other, leaving the sawed ends exposed, is more in keeping with the nature of the work. These ends should be smoothed, oiled and varnished, the same as the disks. Some bolts were put in to fasten the arm pieces to back and seat of chair, and the legs to set supports. Smaller braces and rustic trimmings were nailed in position.

In the construction of a chair or settee the four most important pieces should be selected first—the rear legs, which also form the back, and the front legs. If possible these should have slight curves. Plan and build the back first, arriving at the size and putting the cross-pieces in position. The front section should then be made. Nailing the arm-rests and braces into their respective positions will complete a solid, rigid chair.

Tables are easier to build than chairs or settees. Careful measurements and simple tools are all that are required, and a great variety of chairs, tables, settees, desks, rustic baskets, and other useful articles may be made. The material, in most cases, may be gathered during a tramp through the woods in vacation-time, or it may be purchased at little cost.

Branches from the wood lot, limbs pruned from fruit orchard or shade trees, small tamarack or birch trees and the ordinary willow from some swampy spot may all be used to good advantage. The making of the furniture is more of a pleasure than a task.—J. E. WHITEHOUSE.



Dimensions of each piece of furniture shown in the halftone illustration above. These dimensions are not arbitrary but merely give an idea of about the right proportions for comfort

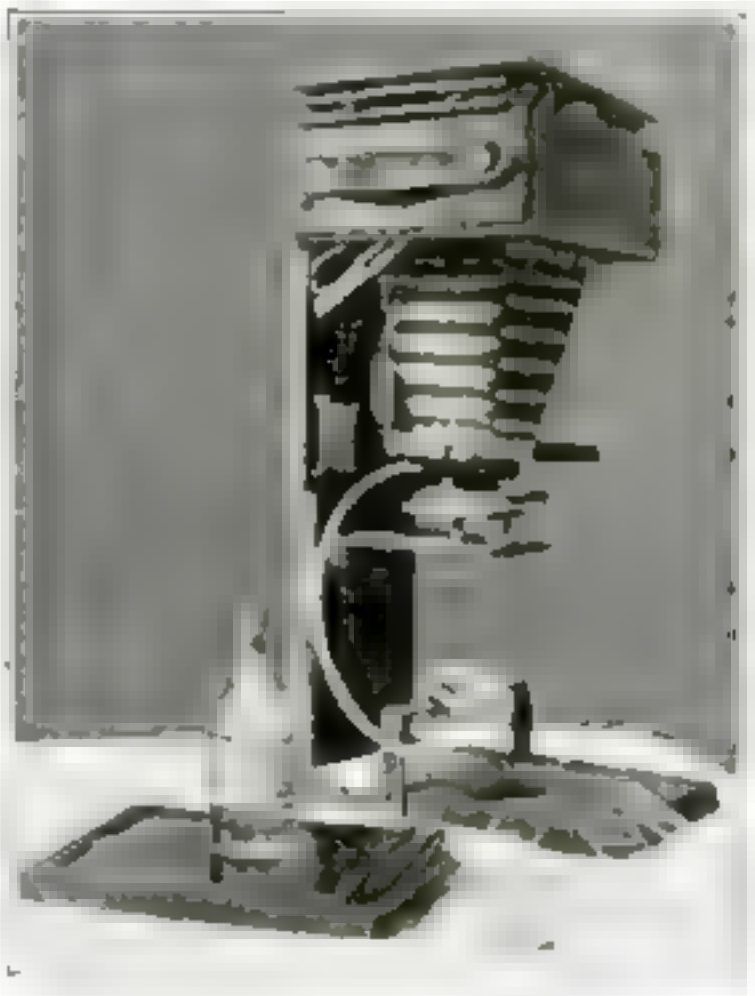
Using a Drop of Water for a Lens

It Is a wonderful magnifier in microscopic photography

By Frank M. Gentry

EVERY amateur photographer will be glad to learn of a method that is both simple and inexpensive, by which he may make perfectly clear photographs of microscopic objects.

It has been known ever since the first scientific investigations of the refractive properties of different substances, that water, if it could in some practical way be held in shape, would form a lens of extraordinary value. Moreover, it is also well known that a drop of water held by capillary attraction in a loop of wire forms a wonderful magnifying lens. The question, therefore, arises, "Why not use this drop of water as a photographic lens?" An explanation of how this might be done follows:

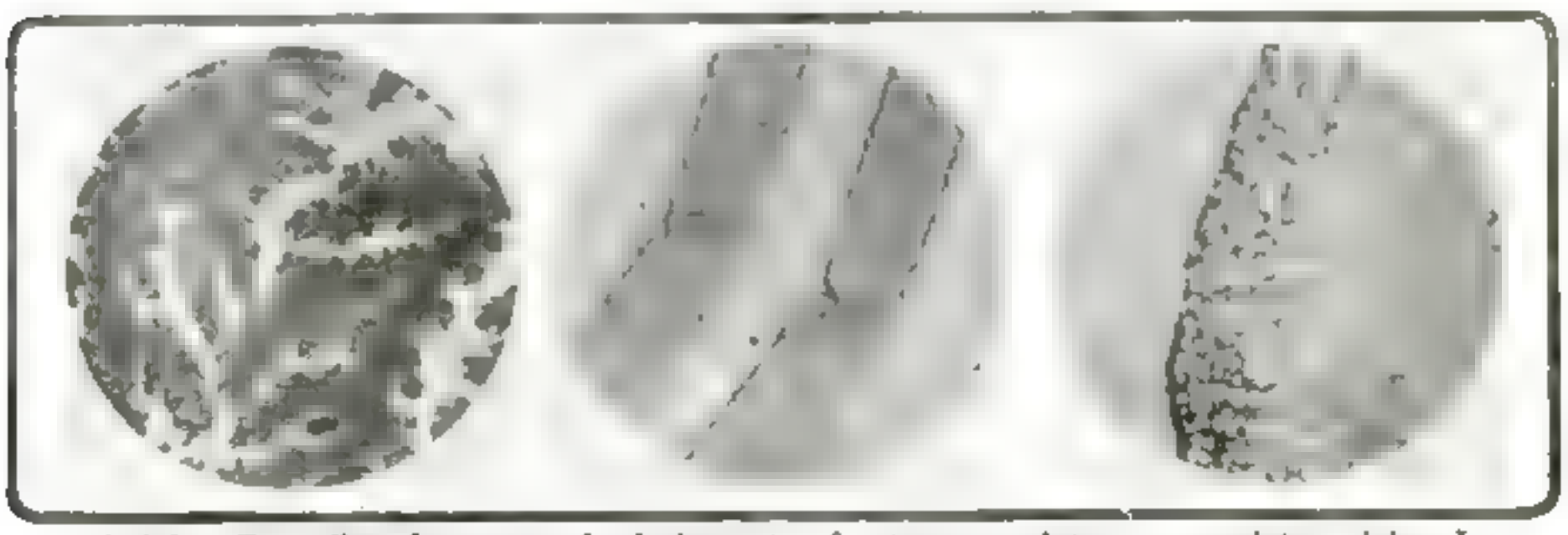


The camera as it is mounted on a pedestal for microscopic photography

The first step is to cut a disk *A* from very thin copper to fit the lens cell of the camera. In the center of this disk, *B*, there should be bored a 1/32-in. or smaller hole. The smaller the hole is, the more perfect the lens will be and, therefore, the greater its working capacity. The edges of the hole should then be rubbed carefully on an oilstone so as to remove all the little particles of projecting copper. Great care should be taken to follow accurately these instructions, as the result will depend on your faithfulness in this respect.

Next remove the lens from its cell; reverse the threaded ring which held it in place; insert the copper disk, and screw in place with the ring. The result may be seen in the illustration on page 125, where *C* represents the lens cell; *D*, the threaded ring; *E*, the copper disk, and *F*, the drop of water. The cell may now be screwed back into the camera until ready for use.

In order to place a drop of water in the hole, a wire should be bent as shown at *G*. Dip the straight end into the water. When it is removed, the drop that adheres will be just enough to properly fill the opening. Patience is required to place the drop accurately so that it will not run over the edges, which would be disastrous. The operation may consume over an hour but the results well atone for the trouble. Glycerine or castor oil may be used in place



At left Crystalline formation of a bichromate of potassium solution on a gelatine slide. In center: Portions of the antennae of a beetle. At right: Microtomic cross-section of a stem of fern

of water; in fact, the former may be preferred to it, for, although it necessitates a somewhat longer exposure, it is free from evaporation and is not so likely to be jarred out of place, on account of its superior capillary attraction.

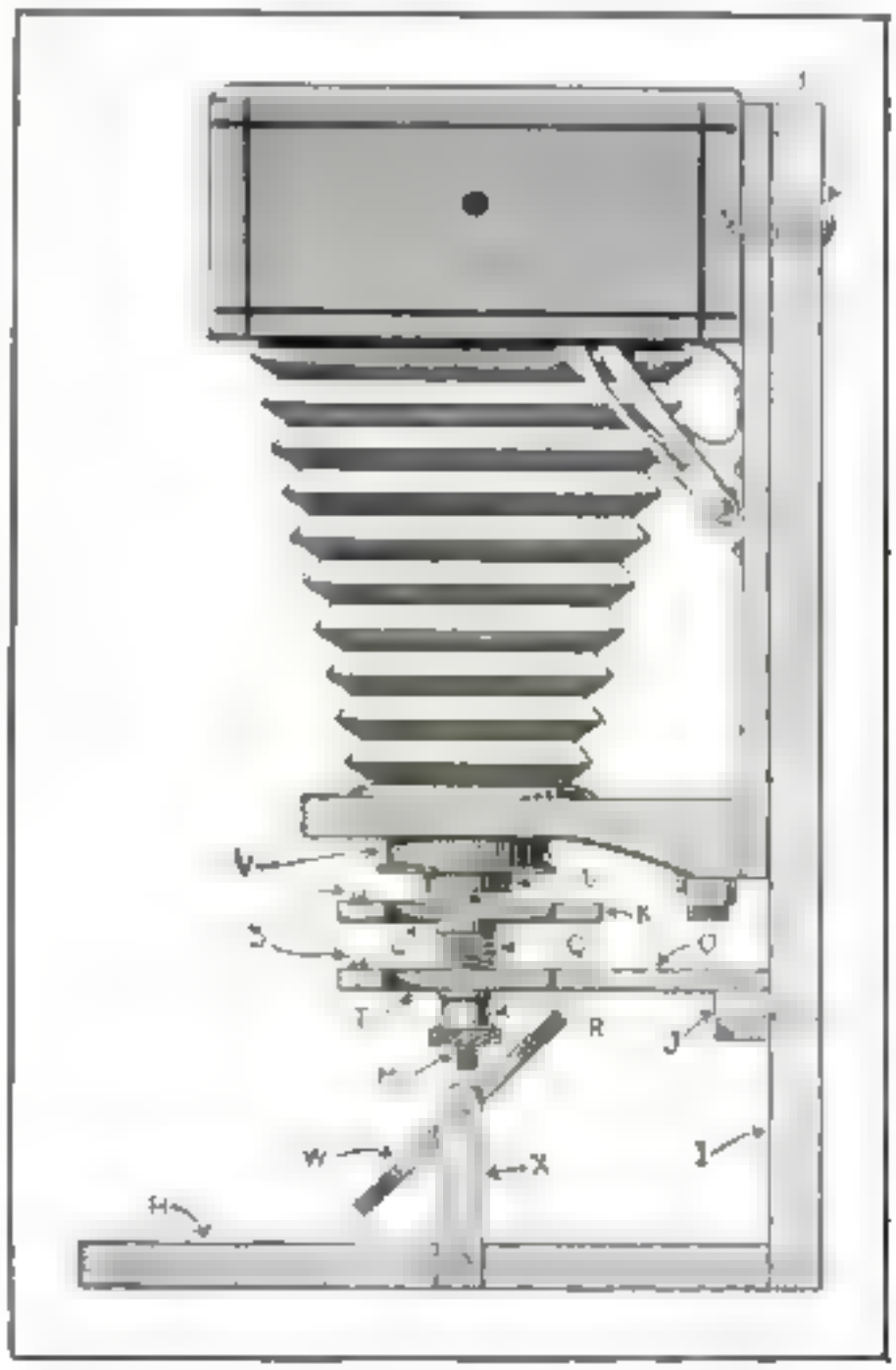
At left: Microtomic cross-section of a rue leaf. Right: The hair on the leg of a housefly

A standard must next be constructed, as shown at *H*, and *I*. No dimensions will be given as the construction will vary with the type of camera employed. Near the top of the standard a ¼-in. stovebolt, *J*, should be inserted and screwed into the tripod socket, thus holding the camera in place.

The adjustable slide-holder is next to be considered. Some time was spent and a quantity of material utilized in devising methods of construction for this important part. The one which proved to be the most successful is shown at *K*. It represents a piece of ⅛-in. wood (a cigar box will do) in which a 1½-in. hole, *L*, was cut. On each side of this hole a 5/32-in. bolt, *M*, was inserted and made stationary by the nuts *N*. A long battery bolt will serve the purpose excellently. Another piece of ⅛-in. stock, *O*, somewhat longer than the other, with a 1½-in. hole as shown at *T*, was also made. To one end of this second piece there was nailed a ½-in. square strip, *P*, which served to fasten the whole part to the standard. On either side of the 1½-in. hole of the second piece, there was bored a hole corresponding to the bolts, *M*, and large enough to permit them to slide up and down easily. Springs, *Q*, were then slipped on the bolts, which were in turn passed through the corresponding holes in *O*. Thumb nuts, *R*, such as are found on batteries, were then screwed on the bolts. By tightening or loosening the thumb nuts, the slide-holder was adjusted to the lens. A strip of spring brass, *S*, was then fastened on *K*, to hold the slide rigid. When it was desirable to use a color-screen in photographing or examining any object, the filler was laid over the hole, *T*, on *J*. The adjustable holder was then mounted by means of a strip, *P*, on the standard near the lens *U*, in the shutter, V. On account of the great magnification the focus is necessarily very short; indeed, it has been found that when a 6-in. bellows extension is used, the focus is not quite 1/16 in.

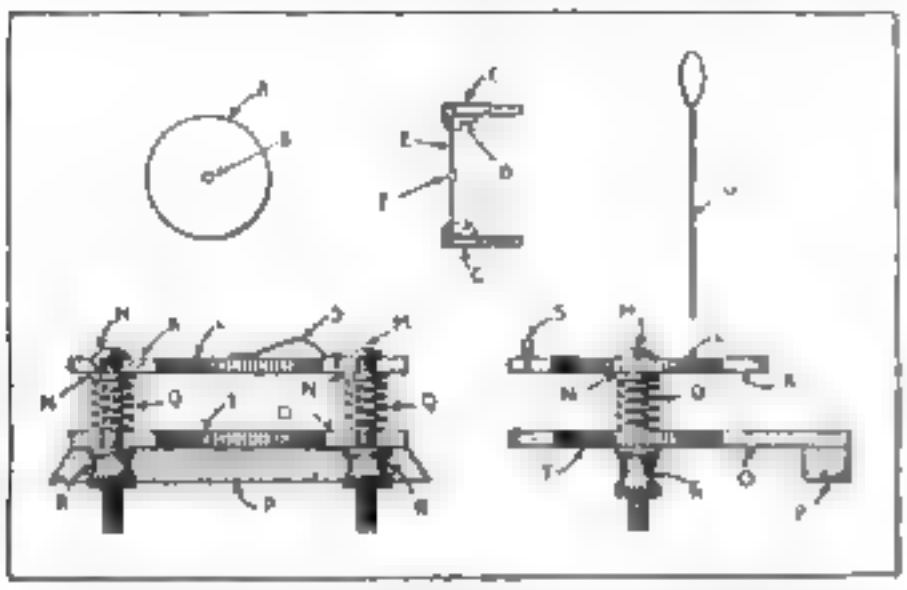
An adjustable mirror, *W*, must be mounted on the standard base, *H*, by means of an axle working on pivots in the strip *X*.

To operate, the object to be photographed must be placed on a thin glass slide which should be fastened by means of the spring brass clip, *S*, over the hole, *L*, in strip, *K*. The bellows containing the water lens must be extended as far as possible. The mirror, *W*, should be adjusted until the direct sunlight is reflected through the slide into the camera. Focusing is then accomplished by tightening or loosening the thumb nuts, *R*, as the case may be. The plate is then placed in position and the actual photographing carried on as usual. An old magic lantern may be used as the source of illumination; but



An ordinary camera attached to support for making microscopic views with a water lens

whatever the source, the light must be very strong. The exposure must be found by experiment, as it varies with the light, size of the lens, the subject photographed and



The disk for holding the drop of water in lens barrel and the slide holder attachment

whether or not a color screen is used. The accompanying photographs show the finished instrument and several of its photomicrographs.

Very convenient slides may be made by cutting old lantern plates the right size. Colored glass makes very good filters when they are needed. It is of course understood that some transparent objects, such as the white blood corpuscles, must be dyed before photographing in order to render them visible.

The magnification of this instrument ranges from 300 to 500 diameters, depending upon the lens and bellows extension. I have successfully examined and photographed blood corpuscles, the starch cells in a potato and various other things by this method. On one occasion while using a magnification of 923.5 diameters the hair on a fly's leg appeared 2½ in. long. Another time, while examining the wing of a recently killed fly I was able to see the watery fluid drying up in the capillaries. To perfect this method several different instruments were tried out during more than a year of experimenting.

The same method of constructing a lens may be used in a similar manner for an ordinary microscope in cases of emergency, but the drop of water will need to be a trifle larger than for the camera lens. It can be made in a small loop twisted on the end of a small wire, allowing sufficient end for a handle.

An Effective Fireproofing for Children's Clothing

IT is a common occurrence for children's clothing to take fire from playing with matches and from other causes. This may be prevented by a little precaution which may be taken every time the children's clothes are washed, particularly the dresses, suits and petticoats.

A non-inflammable solution of 1 oz. of alum or sal ammoniac should be added to the rinse water or starch. This renders the garments practically fireproof. Should they take fire, they would burn very slowly and without flame.—JENNIE E. MCCOY.

Collecting Ants in a Sponge and Drowning Them

ANTS in the house or on the lawn can be quickly eradicated in the following way: Wet a large sponge and sift sugar all over it and place in the infested spot.

It will be filled with ants in a very short time. Sink it in a pail of water and the ants will leave it and drown. Repeat the operation until they are all destroyed.

Exterminating Moles and Gophers by Asphyxiation

IN some of the Western States moles and gophers are a great pest and difficult to exterminate. One of the best methods of getting rid of these animals is to fill their holes with the burnt gases from the exhaust of a gasoline engine. The illustration shows the method used by a Western farmer for the purpose. He attached a hose to the exhaust of an automobile engine and forced the burnt gases into the burrows of the animals, causing death by asphyxiation.

Forcing the deadly gases from the exhaust of the automobile engine into the burrows of moles and gophers

Exhibiting Specimens of Flowers in Single Blossoms

CERTAIN flowers, such as pansies, cannot satisfactorily be shown in bunches, but should be exhibited as separate specimens. To put each in a vase by itself takes up too much room and displays more glass

Glass tubes set in table top to hold water for cut flower stems

than flowers. A good way to exhibit such blossoms is to make a table top of soft wood and bore holes into it for inserting glass tubes. The top of the table should then be covered with paper, through which the flower stems may extend down into the water-filled tubes. Most amateur photographers can soon collect a number of developer tubes, which are just the thing for this purpose. If these cannot be obtained, little "homeopath" vials may be found at the druggist's. These tubes may be arranged in the shape of letters, or if desired, emblematic designs may be formed for table decorations. The effect of each flower standing seemingly by itself without any support is surprising as well as pleasing.—W. H. SARGENT.

A Tracing Cloth Repair That Does Not Affect Transparency

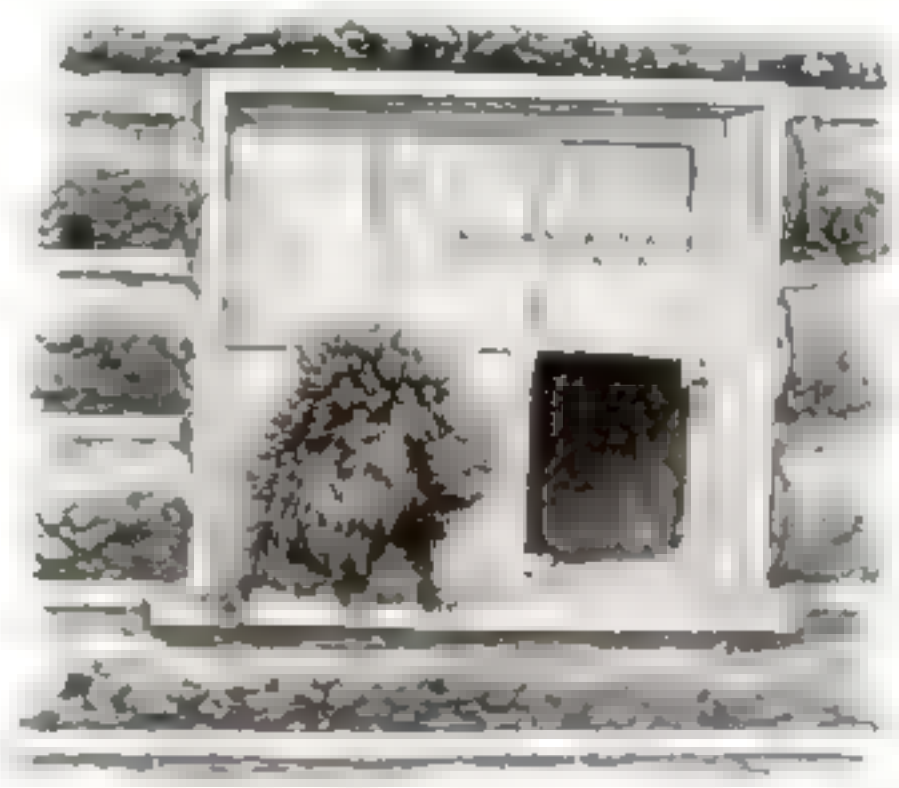
THE principal objection to patching a tracing cloth is that the part covered is no longer transparent enough for making a perfect blue print. If the tear is not too large, apply liquid court plaster to the parts and allow it to dry. This holds the parts together, fills the gap or hole and does not impair the transparency of the cloth. With a little care any missing lines of the drawing may be drawn on the plaster filling the gap.—LOUIS FLEISCHER.

Difference in Curing Time of Parts Makes Poor Tire Repair

SOME repairmen attempt to use materials from two or more concerns on the same job. For example, sometimes a fabric is bought from one firm which cures at 40 lb. steam pressure for 40 minutes, with gum from another firm, curing at 55 lb. for 50 minutes. This combination inevitably results in improper curing of one or the other, or both of these materials. It is best to use one make of repair materials for satisfactory results.

Porcupine Removes Window Pane to Gain Entrance

THE wily ways of a porcupine and its almost human intelligence are illustrated in the accompanying picture. A camping party having food stuffs stored in a cabin, left the place for a few days to go fishing across the lake. They left the door and windows securely locked, but upon their return they found that a porcupine had gained entrance and played havoc with



After gnawing through the window-sash frame the porcupine knocked out the pane of glass

their edibles. The creature evidently tried various ways to get in, but finally succeeded in gnawing through the window-sash frame at the corner and knocking out the glass pane in that section.

Round Belt Guide on a Washing Machine Wheel

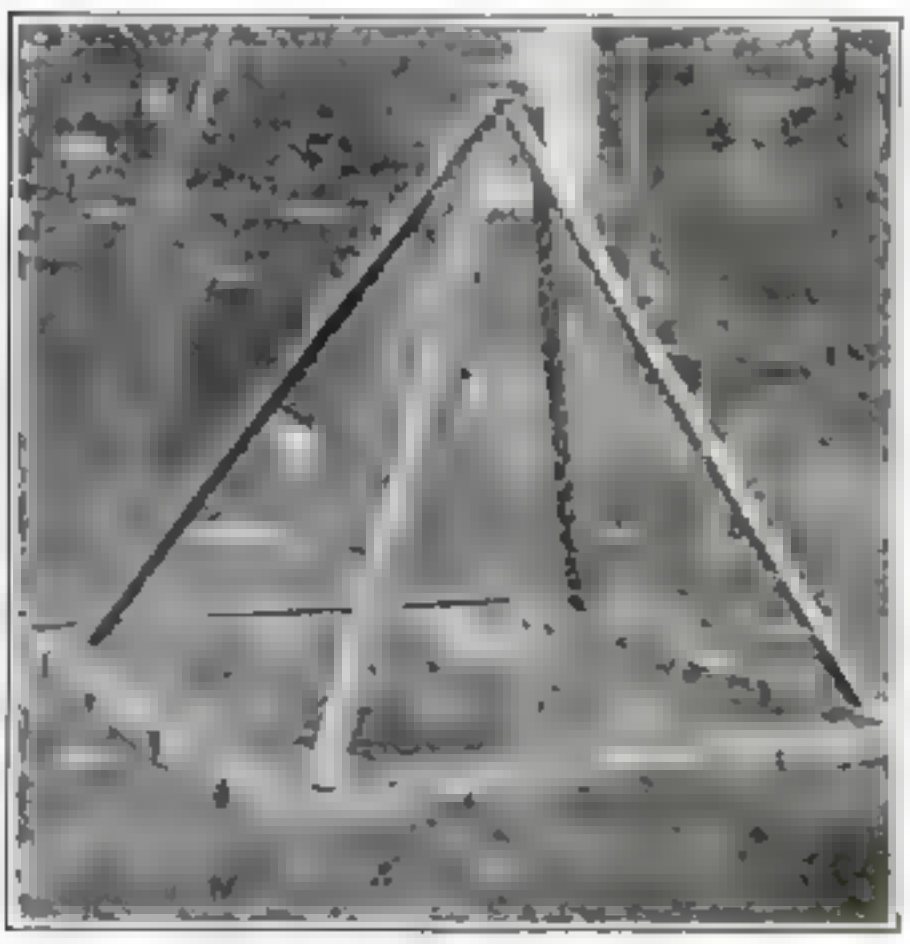
THE circumference of the washing machine flywheel shown in the illustration is divided into eight equal parts and at each division a pair of 3/16-in. holes are drilled. Pieces of stiff wire bent U-shaped and about 4 in. long are slipped through these holes from the inside of the wheel rim and their ends bent outward as shown These wires serve as guides to keep the belt on the center of the wheel.—GEO. C. ROUSCH.

The U-shaped belt guide made of pieces of wire

A Vine Covered Tepee in the Garden for the Little Folks

A VERY attractive tepee can be built of 2 by 4-in. timbers, as shown in the illustration. First lay out a plot of ground and box it in with the timbers, filling up the part within with dirt to the upper edges of the timbers. Near each corner of the frame stand one of the timbers, allowing the upper end to slope toward the center of the square where all four meet. Then tie or spike them together.

Morning-glory vines are planted around three sides of the base and are trained up to trail over wire mesh fastened to the timbers. The fourth side is left open to provide an entrance-way. Lawn chairs and a table may be placed inside. The breeze from any direction can enter such a tepee and the hot rays of the sun will be kept out.—EDWARD F. BIGELOW.



A plot is boxed in and timbers set up in tepee form and covered with wire mesh

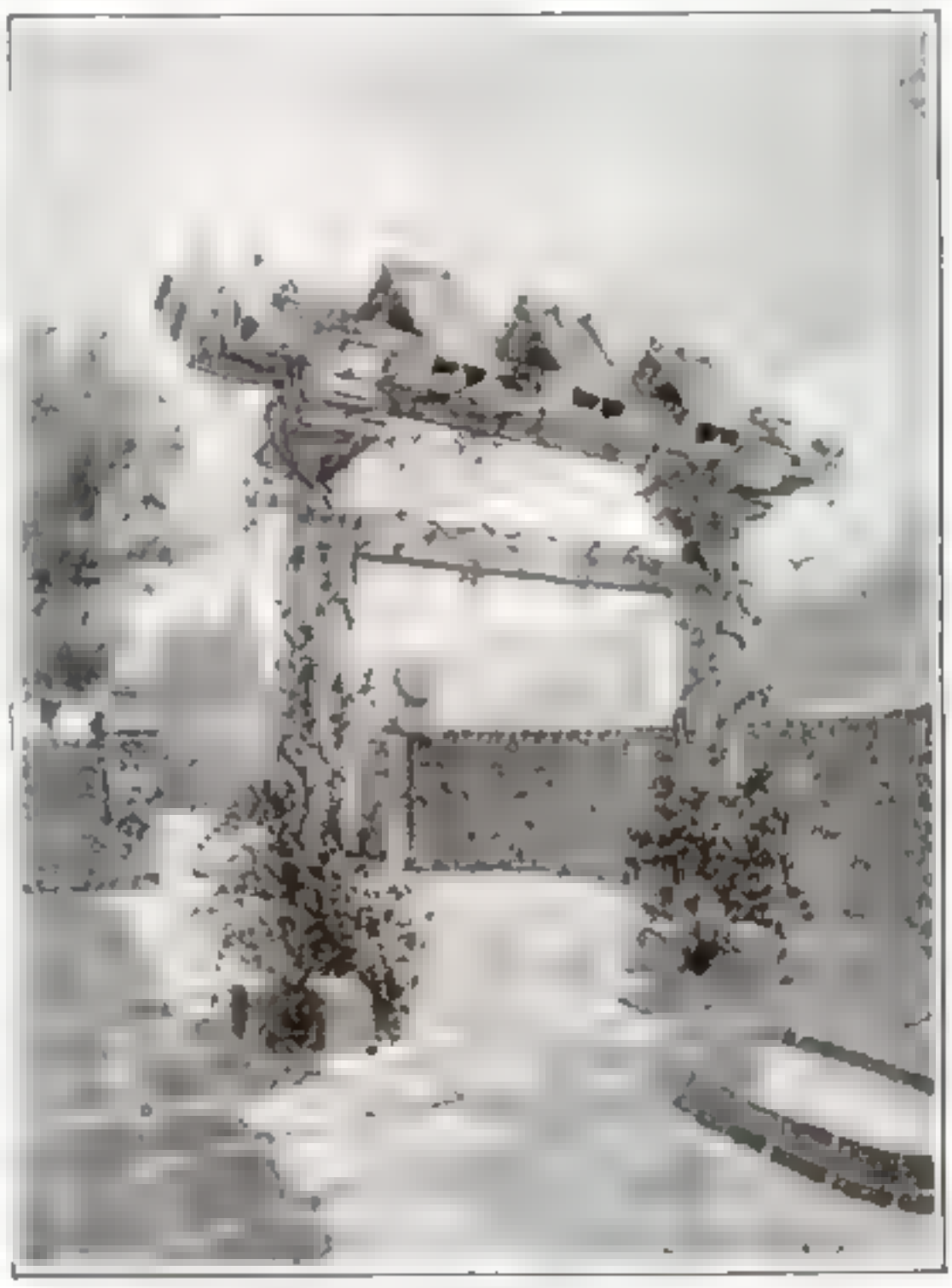
The vine-covered tepee admits the cool breeze and keeps out the hot sunshine

A Shaft-Polisher Made Like a Lemon Squeezer

PISTON rods, mandrels and similar shafts of considerable length turned in a lathe are usually given a high finish. Where no grinding fixtures are available this finishing must be done with files and emery cloth. A polisher for such work that gives more pressure on the surface and does better work with less fatigue may be made on the principle of a wood lemon squeezer. Two pieces 3½ in. wide and ⅞ in. thick are joined at the back with a piece of old belt leather for a hinge. Shallow grooves are cut across the boards on the inside and pieces of emery cloth tacked in them. The leverage gives as much pressure as desired.

Building an Artistic Bird-House For the Garden

THE design as shown by the drawing is an attempt to carry out a pergola effect. The general dimensions are 11 ft. 6 in. from center to center of round columns. From the ground to the under side of upper beam is 12 ft. The diameter of columns at base is 1 ft. 5 in., at the top 1 ft. 3 in. The general dimensions can be changed to suit the particular fancy of the amateur builder, but for satisfaction and to avoid mistakes they ought to be carried out as shown. The columns are of wood of built-up construction, and set in the ground not less than 6 ft. That portion in the ground and 6 in. above ground line is thoroughly coated with tar, both inside and outside. The inside of each column, particularly the lower portion, is reinforced.



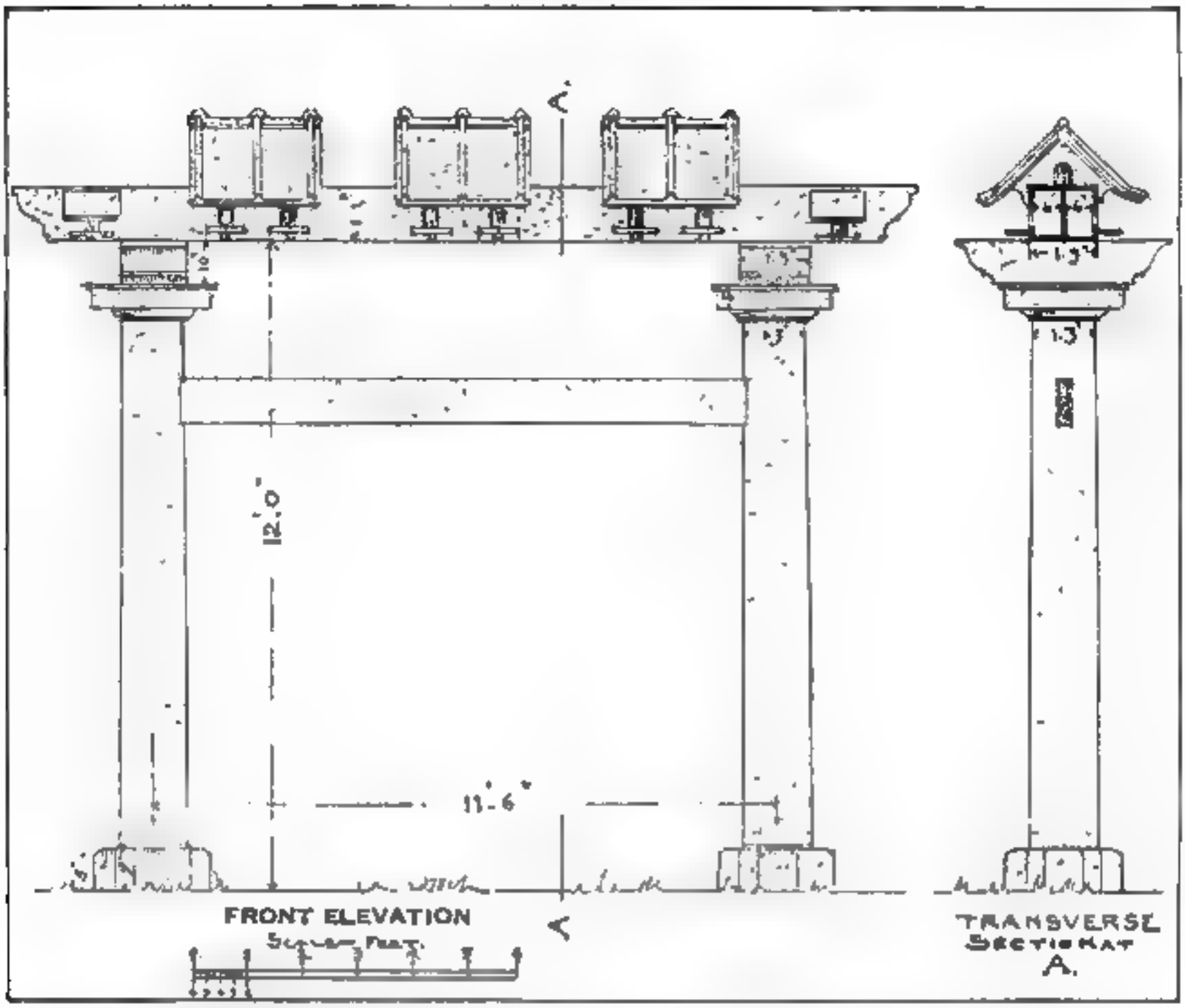
A very neat design for several bird-houses set on the cross beam of a structure resembling a pergola over a walk

It adds much to the stability if that portion of the columns below ground line is in concrete. At the ground line base of the column there is a concrete finish, octagonal in form and about 7 in. high, and on the four sides there is a square block 6 in. high. The edges are slightly rounded. All are built of cement or stone, with suitable foundation. The columns, beams, and other woodwork are of cypress. The column cap is square. On top of each column cap is a wood beam or bracket 4 ft. long, 1 ft. 3 in. wide and 10 in. thick. The ends are shaped as shown. This short beam or bracket is of built-up construction and is laid transversely to the long beam above. On top of these two wood beams, a longitudinal beam is securely set in place. This beam is 17 ft. long, 1 ft. 3 in. wide and 1 ft. 1 in. thick, and is of built-up or box construction. The ends are shaped as shown. The top of this beam slopes from the center to each side. The slope is about ½ in. The top is covered with tin, painted on each side. There are sixteen separate compartments or rooms on each side of the beam, also six more on top of the beam in the gables. There is a wood partition dividing the front and the rear, also cross-pieces, giving each compartment about 6 in. by 6 in. floor space. The height is the height of the inside of beams, or the gabled roofs as the case may be.

Each compartment has an opening with semicircular top. From the floor to the base of circle it is 2½ in. high, the width is 2 in The opening is splayed on the inside, to carry out the drippings during rain storms.

Outside of each opening is a latticed shelf or ledge 6 in. wide with a 9 in. projection. On top of the beam there are gables. Each gable has two compartments, built in detail the same as specified for the lower compartments. The roof of gables is covered with tin. On top of this tin there is wood tile. This tile is thoroughly painted in red and thoroughly sanded.

The openings at each end of the beam have a small slanting roof. The cross beam extending from column to column is made removable.



Diagrammatic drawing showing dimensions and plan. The entire structure is built up of wood for the framework and covered with concrete, the bird-houses on top being covered with tiles

The inside compartments, including the floor, are built independent of the side wall and top, so that they can be let down from below for cleaning. These are held in place at each end with a metal chain which runs over a suitable pulley on the inside of the column and down to a point opposite opening 4 ft. from the ground and suitably secured in place. The opening for access to the above chain has a suitably hinged door. All woodwork is painted a light gray color and finished in sand.

A Printing Process for Imitating Hard Woods

THE art and practice of graining dates back about 150 years, the exact period not being known; hence imitating hardwoods is by no means a modern idea. An expert grainer to do his best, uses only his best; whereas Nature, always variable, gives us her best and her worst, and the result is seen in poor cabinet work. In other words, the woodworker in making up a piece of work will often use pieces of natural wood that are not beautiful and often not matched so that the finished job will not compare with that of the expert grainer.

For some time past there has been a serious shortage of fine hardwoods suitable for cabinet work and, to help out, veneers have been used. For this the wood is sliced into extremely thin pieces or sheets which are glued to a baser wood; or plain woods are stained to make them look like the finer hardwoods. Various methods other than graining have been adopted for imitating hardwoods. About 25 years ago, a Pittsburgh painter invented a machine for filling a board with punctures so that when it was stained the surface resembled oak. The board could be sawed and cut in the ordinary manner and finished in perfect imitation of oak.

The most modern method of graining employs a printing roller. The roller is made of a strong light wood, well seasoned. This may be in the form of a segment of

a circle, in which case it works with a rocking motion. The length of the segment should be sufficient to cover the surface to be grained, otherwise it will be difficult, but not impossible, to make the joint unnoticeable. A full circle roller is made as follows. Take a shaft and fix upon it, by mortise or otherwise, spokes of proper length, according to the size of the desired circumference, and around these spokes run or bend a strip of ¼-in. gum wood. If the ends of the shaft are smoothed off and allowed to extend about 4 in., handles will be provided to hold the roller in operation. Place around this roller the composition for making the print. A large roller may be made with a circular head of 1-in. board having flanges from ¾ to 1½ in. larger than the roller. Turn the roller over and stop all holes with plaster of Paris. The best way to do this is to run the plaster all around the inside of the roller. In the head of the roller, as it stands upright, cut three or four notches along the edge, about 1 by 2 in. to make places for pouring in the composition and for letting out the air. Make a long smooth strip of zinc large enough to cover the roller, rub it over well with grease or oil, then place it around the roller and pour in the composition. The oiled or greased side must be next to the composition. A very large roller will need collar bands to hold the zinc. Draw the zinc around the heads of the roller and pour in the composition through a strainer. Allow it to stand for at least 12 hours before removing the zinc.

Making the Roller

To make a smaller roller form it in a mold made of a light wood frame of the required size, set on a piece of zinc or glass. Pour the composition into it, then lay a piece of canvas on top of it. When cool, attach to a roller or rocker with tacks.

The composition is made as follows Heat 12 oz. of raw linseed oil to the boiling point and add 1 oz. of chloride of sulphur. In another vessel dissolve 2 lb. of the best white glue and when melted add 8 oz. of commercial glycerine. Use as little water as possible in melting the glue. The best way to dissolve or melt glue is to pour enough cold water on the dry glue to cover it and let it soak over night. It will take all the water it can hold. Pour off the surplus water and add enough boiling water to melt it. To the glue add 8 oz. of commercial glycerine and mix well.

Another formula is to dissolve or melt 24 parts of the best white glue and add to it 12 parts of commercial glycerine, which is cheaper than the drug-store brand. For a roller requiring from 10 to 15 lb. of composition add ½ pt. each of molasses and raw linseed oil. To test the composition for consistency, cool a little of it and if it dries too stiff add a little glycerine; if too soft add more glue. This composition should be kept hot until used. Boiling it will do no harm, as this is inclined to drive off more of the surplus water.

Now for the Scraper

A scraper will be required and it is made as follows: Procure a piece of white pine board 12 in. long, 4 in. wide and ⅞ in. thick and make a groove in one edge of it 1 in. deep in which a piece of sole leather is placed after giving the depression a good coat of glue. The piece of leather should be about 1½ in. wide and as long as the board. The edges of the board should be planed down so that it will not interfere with the projecting ½ in. of leather.

The printing color should be a little heavier than oil paint. It is composed of pigments ground in Japan. A board is the next requisite. It is made from the kind of wood to be imitated. Select as fine a figured specimen as possible and make it perfectly smooth and even of surface. This board must be 6 in. wider and 1 ft. longer than the circumference of the roller. Nail thin strips around the edges of the board, allowing them to extend 1 in. above the surface. Bore a ½-in. hole in one corner through which to pour off the liquids when cleaning it off. With the board ready, prepare a solution of 1 lb. of concentrated lye dissolved in hot water and pour it on the board's surface, allowing it to remain for 20 minutes. Then pour it off through the hole in the corner and rinse with clear water to remove the lye, after which flow a little vinegar water over it to neutralize the lye. The board is then left to dry out thoroughly, after which it may be lightly rubbed with fine sandpaper. The lye removes the soft fibers of the wood, leaving on the harder grain an effect similar to etching. The board is then ready for the printing process; but first try it by making a print from it on paper. If it shows an imperfect or faint print apply the lye solution again. Pour some of the printing color on the impression-board through a strainer. The printing color is made into

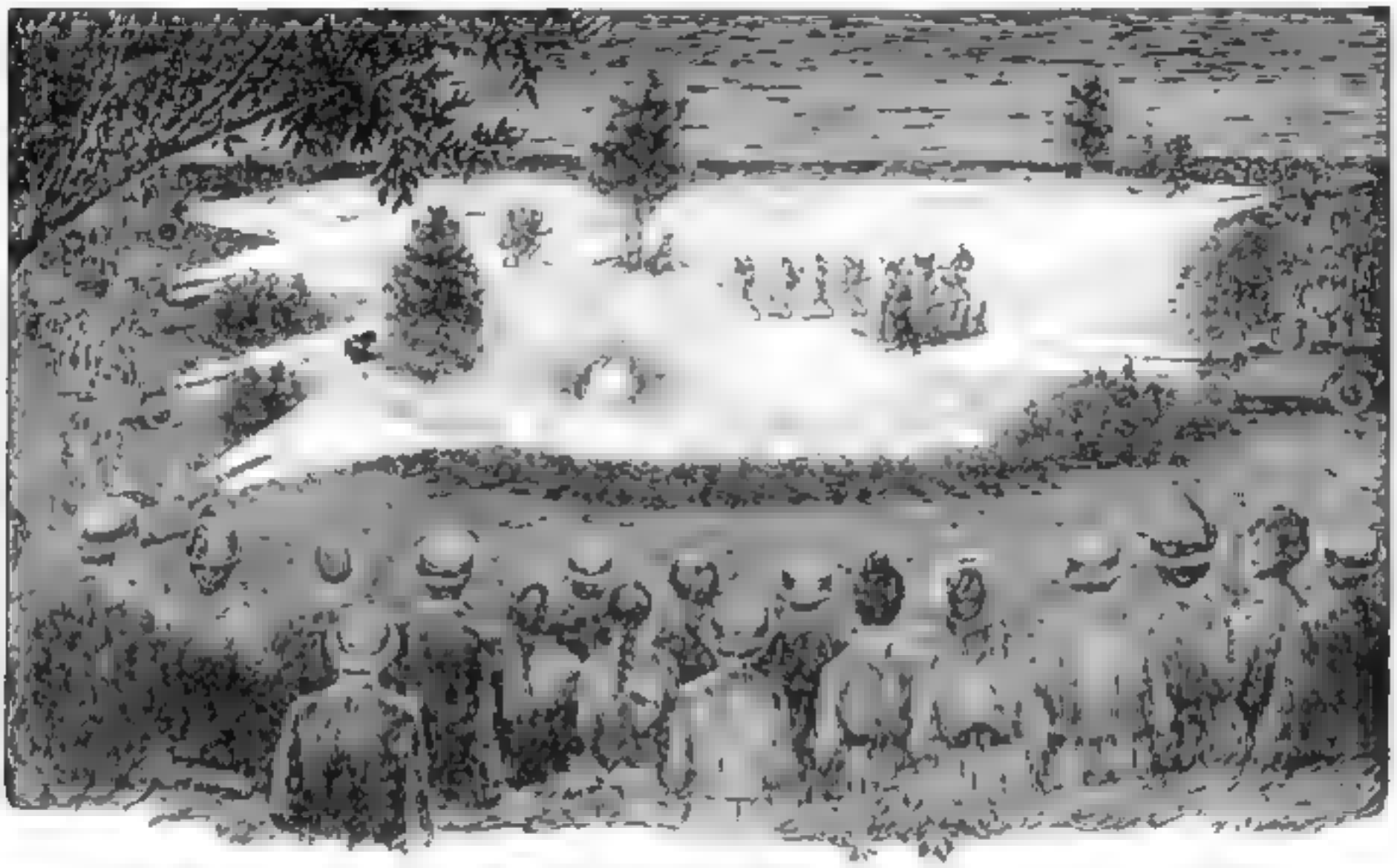
a paste form with turpentine, working it as smooth as butter. When ready to use, thin out with more turpentine and add a little boiled linseed oil, which is to keep the paint from drying on the board. Do not make the printing color too thin; use plenty of it so that the sunken parts will be filled level-full. Then with the scraper spread the paint out evenly, pushing the tool forward, using both hands to press it down hard. This will leave the sunken parts full and the high parts smooth.

With everything ready and the impression-board filled with color, take the roller in both hands and select a point on the roller-surface at which to start. Place this part down on the board, and with a firm, even pressure roll it along over the surface until one complete revolution is made. Be careful to stop when the starting point of the roller is reached. This is to avoid making a lap. Carefully pick up the roller, not permitting it to slip on the board, and place it down on the surface to be grained.

The first impressions from a new board are seldom good and for this reason it is better to make several on some other surface until the board gets into proper shape. When you have finished with the board and roller clean them off with benzine and a stiff brush.

An Improvised Stage for an Out of Doors Fairy Play

AUTOMOBILES, four on the right and two on the left, furnished most of the light for a fairy play, "The Merman's Pipe," produced under the direction of Mrs. A. J. Commons, at Merrill Springs, Wisconsin, for the benefit of a rural school social center five miles away from any stage machinery or electric lights. Each car was so turned as to throw the rays of the lamps on some important scene. In that way they provided six areas of spotlight.



The brilliant rays from the headlights of six automobiles and a number of lanterns furnished the spotlights and footlights for a fairy play given at night in a far-from-the-city locality

For footlights the farmers brought their lanterns. The producer arranged these along the inside of a screen made out of the finest poultry wire interwoven with leafy branches. Sheets of tin reflected the light upon the stage. One scene in the foreground demanded stronger illumination. There a large carriage lamp was used instead of a lantern.

The lake shore was the background; but that was not essential, for the play was repeated later where there was no lake. A green curtain hung on wires, with brush, leaves, and rushes fastened to it, gave a dense leafy drop that helped out wherever Nature failed to provide the proper screens of foliage.

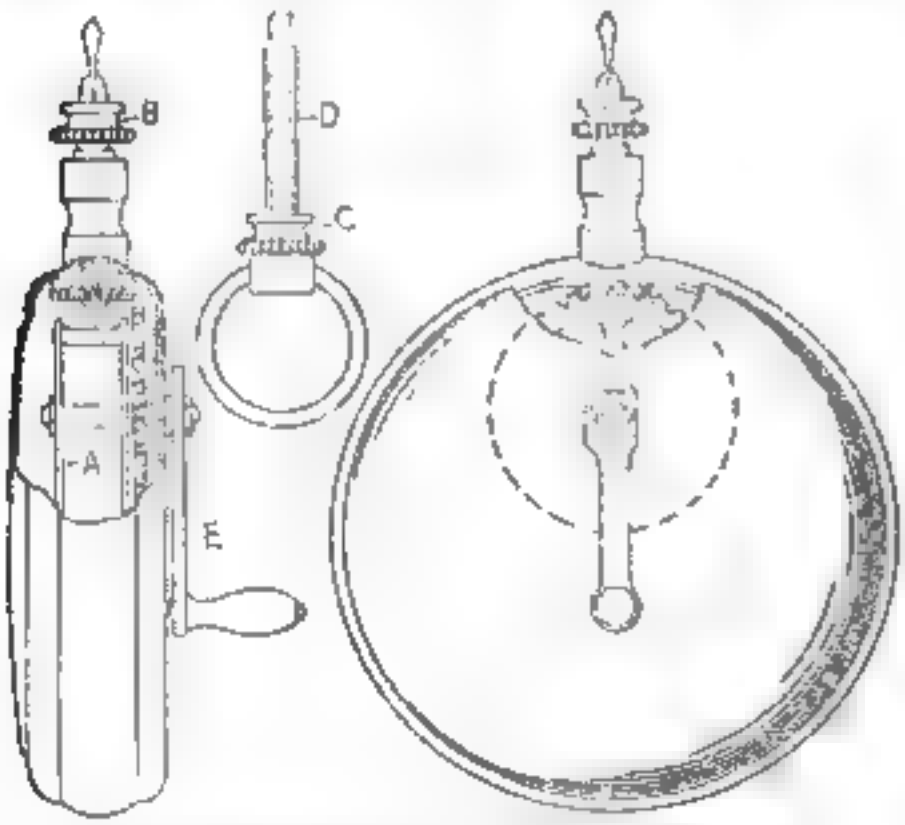
A phonograph behind some convenient bushes took the place of an orchestra. Another clump of trees served to show where the fisherman's hut was supposed to stand. Such was the stage and its machinery. The audience, seated ancient fashion upon the hillside, enjoyed what was probably as lifelike a presentation of fairy-land as could be produced by human beings.—SHIRLEY L. SEIFERT.

An Experiment in Optics Using Heated Graphite

AN interesting experiment in optics may be performed in the following manner: Take a bit of hard graphite, such as a lead pencil, and hold it in the tip of a candle flame until it is completely covered with soot. It will then appear black in the air, but lay it in some water, completely covering the lead part, and it will appear like silver. The explanation of this phenomenon is that the water is unable to touch the object, due to surface tension and lack of cohesion. The water then acts like an unsilvered sheet of darkened glass, reflecting the light.—THOMAS W. BENSON.

Small Hand Drill Made from a Cheap Watch

IN doing some very fine repair work it was necessary to use a smaller drill than could be used in a breast drill without



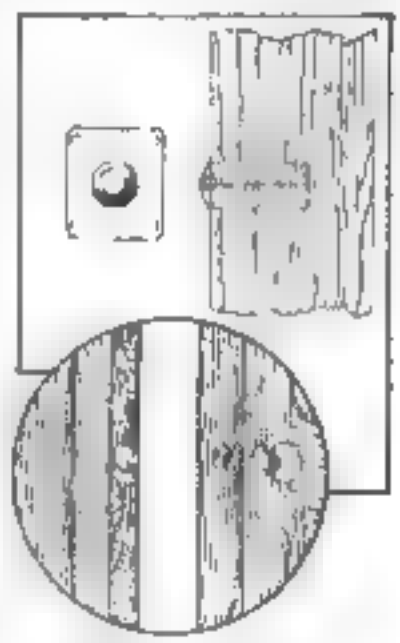
Two small clock gears used in the frame of a cheap watch to drive a small drill point

breaking. To accomplish the drilling of very small holes I made a drill driver of an old dollar watch and some parts taken from a discarded alarm clock. All the wheels, ring and winding stem of the watch were removed, keeping the frame intact, as shown at *A*. The drill chuck and drive shaft *B* were made from the ring bolt taken from the alarm clock. The nut *C* was cut on the dotted line and the knurled part used for tightening the slotted end of the bolt on the drill shank. Of course it is necessary to drill a hole and saw a slot across it in the threaded end of the bolt for the chuck jaws.

Two suitable gears were taken from the clock movement and arranged as shown in the watch frame. The bolt is filed or turned down to the dotted lines *D* to fit into the hole in the watch stem. A crank is attached to the driving shaft as at *E*. The handle for the crank is made from one of the feet on the alarm clock, the arm being cut from a piece of sheet metal.

A Snap-Fastener for a Small Cupboard Door

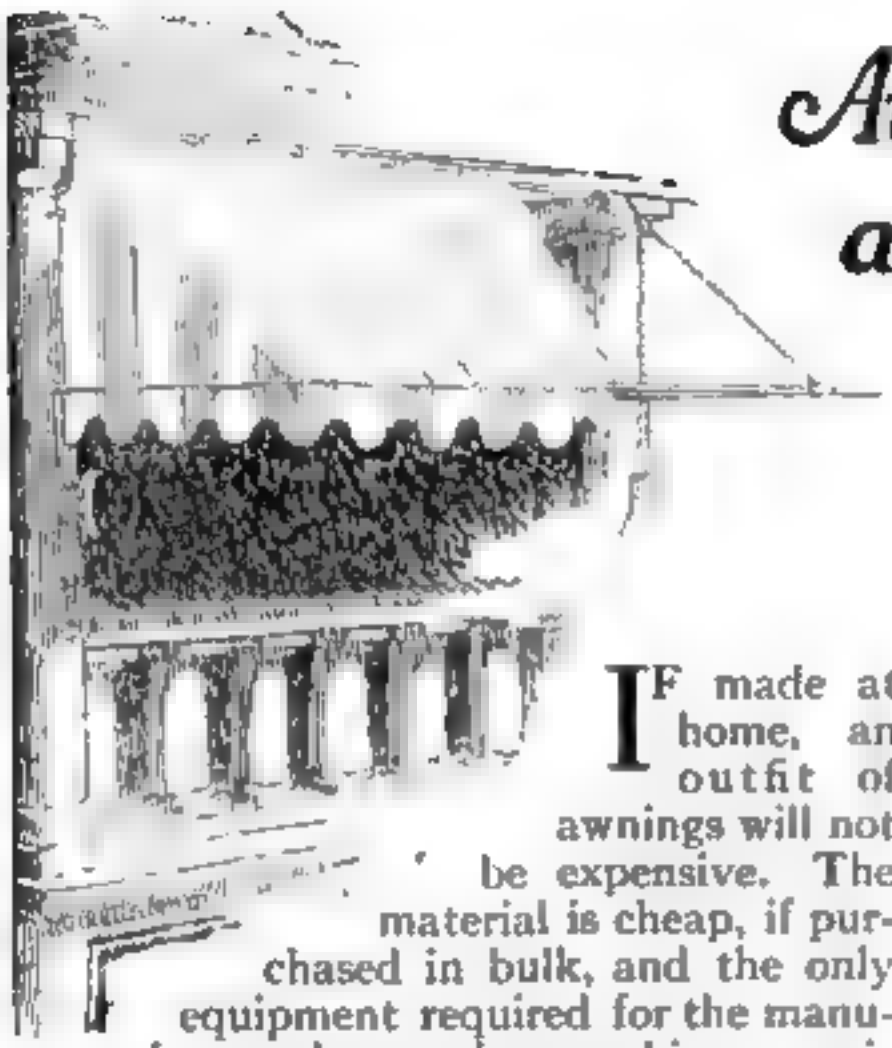
AN efficient fastener for small cupboard doors can be quickly and easily made from a brass-headed tack, a piece of soft rubber, a small piece of tin and a few small nails. Bore a hole in the edge of the door ⅜ in. in diameter and at least ½ in. deep at the location for the fastener. Cut a piece of the soft rubber to a shape and size that will entirely fill the hole and drive the brass-headed tack into the rubber as shown in section drawing, taking care, however, that the tack is not long enough to enter the wood at the bottom of the hole.



Snap-fastener placed on a cupboard door

Cut a piece of tin or other sheet metal about ¾ in. square and form a depression in its center that will be just the size and shape of the head of the brass tack. Punch a small hole in each corner for nails.

In order to find the exact spot where the plate should be placed, open and shut the door a few times, causing the tack head to draw a mark on the door frame. At the extreme end of this mark make a shallow depression. Place the convex surface of the plate in this depression, tack it into place and it is ready for use.

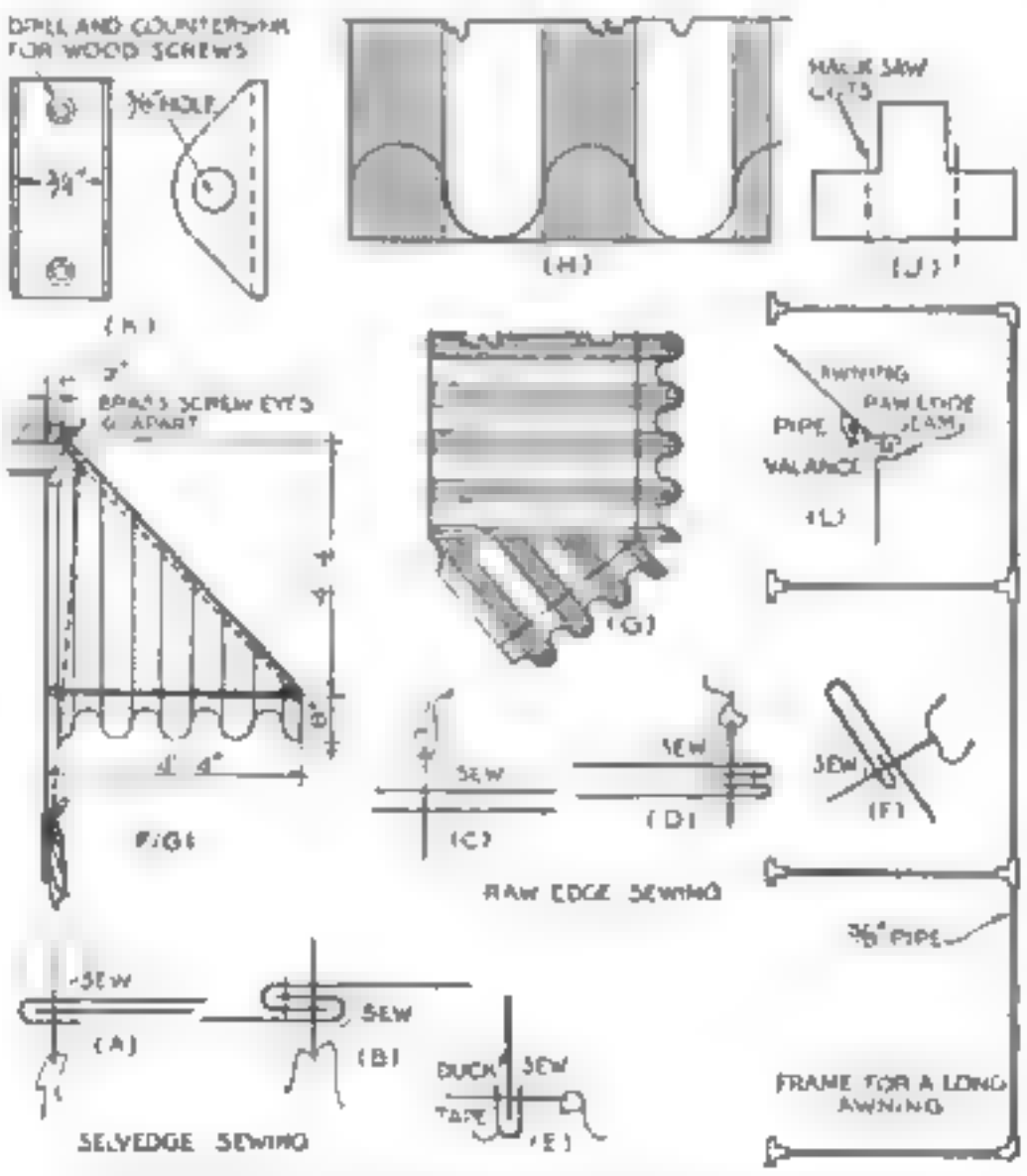


Awnings for the Veranda and How they are Made.

By H. S. Tallman

IF made at home, an outfit of awnings will not be expensive. The material is cheap, if purchased in bulk, and the only equipment required for the manufacture is a sewing machine, a pair of shears, a small pipe-wrench, a hack-saw, and a ⅜-in pipe die. The frame is made from ⅜-in. galvanized pipe and fittings. Black pipe will rust. For example take an awning 24 ft. long, supported on four pillars, and having about a 4¼ ft. reach. Assume a porch 9 ft. from floor to plate. The fringe or valance should not be nearer the floor than 4 ft. when fully lowered. This will protect the eyes when sitting from an almost level sunlight. Measure the porch, and chalk out on the floor a profile view as shown in Fig. 1. Put a 2-in by 1½-in. batten along the front of the plate as shown. This takes the screw eyes used to fasten the awning at the top, and prevents marring the paint. It can be taken down by removing a few brass screws when the awning is stored for the winter season. Chalk the position of the batten on the diagram. Lay off the outline of the end piece, remembering to allow 8 in. for the balance. If the material shows alike on both sides, it will save waste in cutting the end pieces. If it has alternate stripes of white and a solid color, this is sure to be the case. Otherwise it must be examined carefully before cutting, to make sure that no difference in appearance is visible.

For the canopy, cut the goods into lengths of exactly 7 ft. This allows a 2-in. hem at the top, 6 ft. 1½ in. for the slope, 8 in. for the valance, with an allowance of ½ in. for take up where it folds around the frame. In selvedge sewing, lay the two pieces with selvedges parallel, one projecting about 5/16 in. past the other. Turn this projecting edge over the other, and sew as shown at *A*. Then unfold until flat and sew again as shown at *B*. Repeat this process with each selvedge joint until the required length is put together. Be sure the sewing machine takes a fairly fine stitch, properly locked, and does not draw.



The manner of making the cloth joints and sewing the seams, also the details of the pipe frame

When completed, draw each seam over the edge of a table or the back of a chair to smooth it and equalize the stitching. For a 24-ft. awning it should be about 24 ft., 1½ in. long. The selvedge seams have each taken up about ¾ in. If the

goods are 36 in. wide, there are eight of these seams. So 6 in. have been lost. This requires a portion of another strip 8 in. plus 1½ in. plus ¾ in., equal to 10¼ in. wide. Along the top edge, turn back *2* in.; turn under the raw edge, and sew as indicated at *F*. The end flap is next attached as shown at *G*, using the method shown at *D* and allowing the finished heading to stand outside. If the stripes are of equal width, get a tin-can lid, a tea-cup, or other circular object the same diameter as the width of stripe, and with chalk draw a line on the goods half the width of the stripe from the edge of the valance, which must be first trimmed straight and true. Scribe alternate semi-circles in successive stripes, and cut out a wavy line on this scribing. The raw edge so produced must be bound with woolen tape, which can be purchased where the cloth is procured. It will take about eighteen yards of tape to bind the valance for this awning.

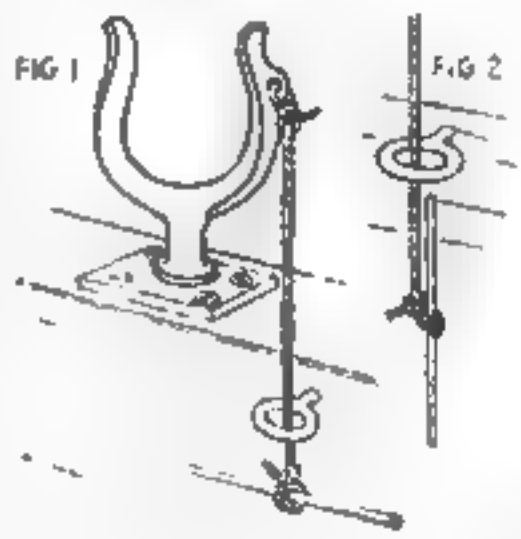
An alternate method would be to cut a slash, 4 in. long and 1 in. wide, ½ in. on each side of each stripe line, or each alternate stripe line, if the stripes are equal and regular. For an irregular stripe a spacing can be selected and repeated without regard to the stripes. This method will require 30 to 40 yards of tape for binding. Be sure to use wool tape in red, blue, white or green, all of which are fast colors. Cotton tape is always bleached by the weather.

The frame is made of ⅜-in. galvanized pipe and malleable fittings. Cast fittings are too bulky. For this frame two elbows, and six tees are required. Four of these tees, which form the hinges against the porch posts, must be cut with a hack-saw, as shown at *J* in the drawing. This will reduce the length of the tee arm to about ⅝ or ¾ in. From a piece of galvanized sheet steel, say ⅛ in. or number 10 or 12 gage, make four double brackets as shown at *K*. Drill and countersink these on the center line of the back for two 10 by 1¼-in. wood screws. Drill a hole for a short ⅜-in. bolt through both ears. When they are finished this far, drop them in a glass jar filled with bluestone solution, 4 oz. bluestone or blue vitriol to a pint of water. Leave them for several hours. Remove from the jar and dry. Polish them with an old rag, and you will find all the spots left after the galvanizing was removed are now plated with copper and rust proof. If dipped in strong vinegar before placing in the bluestone bath they will plate more readily and take a heavier coat. Do the same with the cut tees and the hinge bolts.

When all this is attended to, the frame is assembled by screwing up the threaded ends of the pipe into the fittings. Make up good and tight, everything square, and lay the awning down as shown in *G*, lay the frame on it in the proper position, and proceed to put on the pocketing material. This is a strip of the awning material, 3 in. wide and 7 ft. long, sewed to the line where the slope stops and the valance begins. When sewed true on one side, turn the strip over the frame and sew to the awning above the frame as shown at *L*. This must be done along the front so that the weight of the frame holds the awning taut when lowered. For the ends, it is only necessary to put on a strip of the material 3 in. wide near the hinge. All raw edges of the valance as well as the seams for the ends and where the valance joins the slope, should be bound with the wool braid, carefully run on by machine. Soft laid cotton cord about ¼ in. in diameter, run through small galvanized-iron pulleys, will serve to raise and lower the awning. A lead of this should be placed in the center of each panel and all cords led to one end where a cleat is provided to fasten them.

Fastening an Oar-Lock to Keep It from Falling Out

IF an oar fits a lock snugly the lock is likely to be pulled out of the socket when the oar is removed, and it may be lost. I have found that fastening such a lock in the manner illustrated will prevent this. A stout cord is tied to one arm of the lock and run through a screw-eye turned into the block or oar-lock base as shown in Fig. 1. A small metal bar is fastened to the other end of the string. The bar when turned parallel to the string, as in Fig. 2, can be slipped through the eye of the screw. To keep the bar from slipping out of the knot a depression should be filed out in its center, circling the bar.—G. P. LEHMANN.



Fastening an oar-lock securely with a string

A Boomerang Flyer

by J. S. Zerbe

A LITTLE gyroscopic flyer which can be adjusted so it will return like a boomerang can be made by any intelligent boy. Excepting the shaft, every part can be made with such simple tools as a jack-knife, a pair of pliers and a hammer. The only outside work required is the boring of two small holes in the shaft. This a watchmaker or jeweler will do.

The flyer may be made any size, but as the power which is available must be considered, the following dimensions are suggested: The disk *A* should be 10 in. in diameter made of a thin tar board, for this material is absolutely flat and does not warp or twist out of shape. Aluminum is also serviceable. Unlike the common gliders, lightness is not the first consideration. On the other hand, weight is of considerable importance, as the ability of the device to soar depends on the momentum of the disk itself. In using aluminum, No. 28 gage is the best thickness.

Centrally in the disk is a hole to receive a 3/16-in. steel rod *B*, 4 in. long. Exactly in the center the rod is bent at right angles so that each part, *B* and *C*, is 2 in. long. The part *C* is bent laterally, at a point midway, as shown at *D*, so that it will lie flat on the disk, and an end *E* is turned up so it will serve as a crank handle. The object of this arrangement is to provide a means whereby the disk can be rigidly fixed to the stem so the plane of its surface will be maintained perpendicular to the stem *B*.

After the stem *B* is placed in the central hole of the disk, wire staples *F* may be used to fasten it firmly, as shown. Through the stem portion *B* two small holes *G* are drilled ½ in. apart, to receive a bent pin or wire *H*, which provides a means for attaching a rubber band.

The body of the flyer is made of a strip of pine *I*, 9½ in. long, 1 in. wide and ⅜ in. thick. The interior portion of this strip is cut away to form an upper and a lower bar. The forward end is tapered off to form an A-shaped edge, while the rear end has a blade *J*, made of thin aluminum 2 in. long by 1½ in. wide, to serve as a rudder. The metal should be thick enough to remain set after bending in either direction.

A hole is bored vertically through the upper and lower bars of the frame to receive the stem *B*. A short tube *K*, ⅜ in. long, is placed on the stem between the disk *A* and the upper edge of the strip *I*, and a thin washer *L* is placed between the pin *H* and the lower side of the upper bar. By this means the stem *B* is held rotatably fixed to the frame.

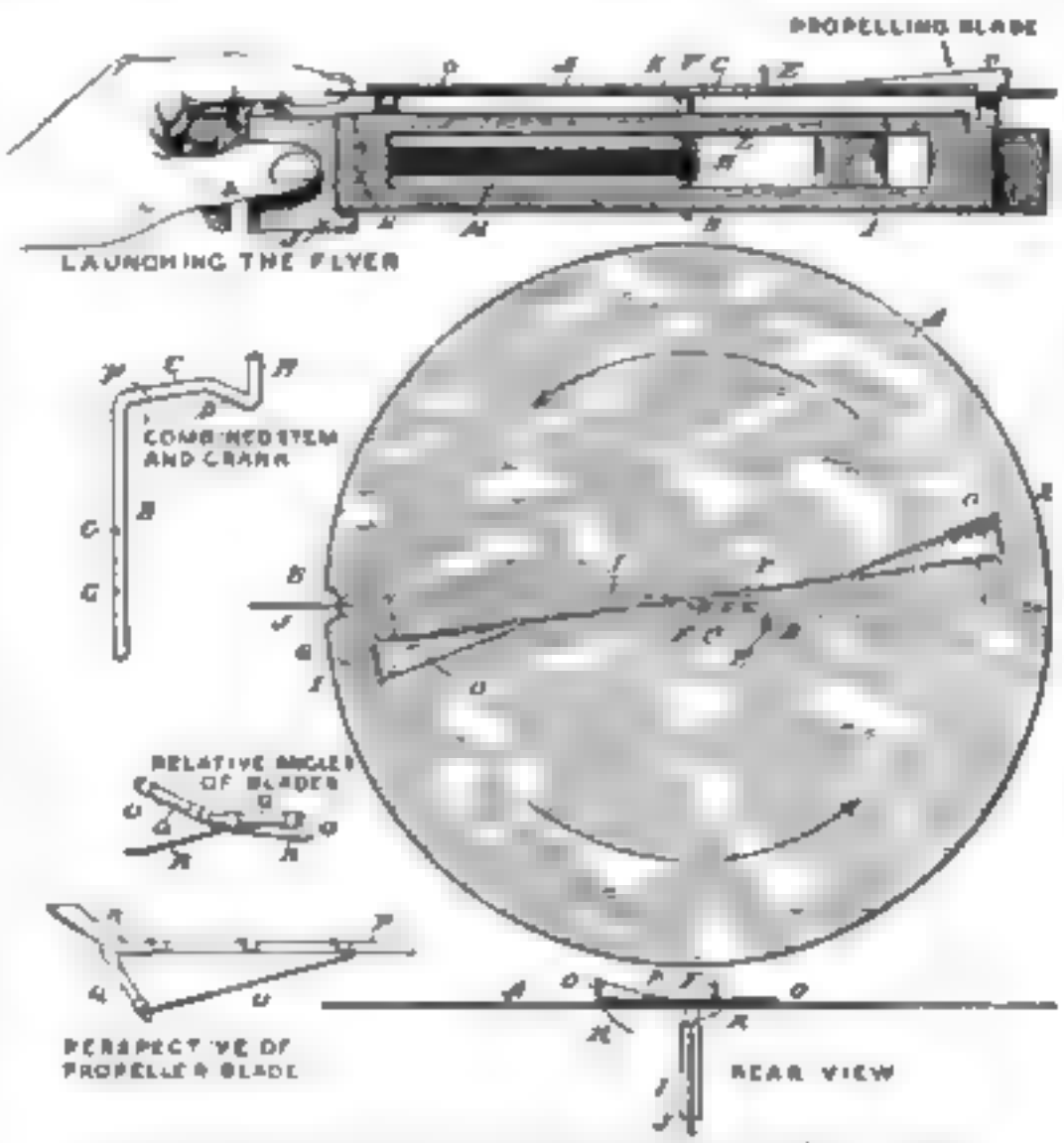
The rubber band *M* which serves as the motive power, should be 4 in. long by ½ in. wide, a size easily obtained. The rear end of this elastic is secured to the side of the strip *I* by means of a wire staple *N*.

If the elastic band is wound up and the flyer thrown into space it will sail along with remarkable evenness of flight, due to the gyroscopic action of the rotating disk. The propelling device consists of a pair of triangular-shaped blades, *O*, secured to the opposite ends of a light wire rod *P*. This rod has at each end a projecting right-angled bend *Q*, to which the blades are attached.

Each blade has at its rear margin a downwardly-projecting and rearwardly-extending finger *R*, which passes through a slit in the disk *A*. These fingers have two functions; first, to hold the propelling mechanism in place, and second, to rock the wire rod *P* back and forth. The

blades, *O*, are set at an angle relative to each other, so that when one lies flat on top of the disk, as is shown in the illustration on the left side, the other blade, on the right side is raised, thus causing the latter to strike against the air and draw the flyer forward. As each blade passes the rear end of the frame *I*, the finger strikes the upper edge, thus rocking the rod so that while one blade is traveling around with the disk from 1 to 2, it offers no resistance; at the same time, the other blade, traveling from 2 to 1, serves to pull the flyer, because it is elevated to catch the air.

After the elastic *M* is wound up to get the desired tension, the rudder *J* is grasped between the thumb and second finger, and the tip of the forefinger is placed in the notch *S* of the disk *A*. Preparatory to flight the finger is removed from the notch, and when the elastic motor has set the disk in motion the thumb and finger release the flyer and a forward motion is imparted to the device. If the rudder is set straight the action of the rotating disk tending to turn the frame, will cause it to fly in a circle. By bending the rudder to the proper angle and initiating the flight at the correct inclination the device can be made to describe a circle and come down close to the starting point.



A thin flat disk with projecting blades which propels the flyer in the direction set by the rudder

By properly adjusting the rudder it will make a straightaway flight and sail a long distance after the power has ceased to act, because in that case it simply acts as a skipper. The frame *I* should be heavier at its rear end so as to give it normally a positive angle, and this can be provided for by a sliding block *T* between the upper and lower limbs of the frame, which block can be moved back and forth until the right adjustment is obtained. This type of flyer has the advantage of durability, as it is not readily injured. No part of the mechanism is exposed to obstructions which it may meet in the path of its flight.

How to Cut Roses So That the Plants Are Not Injured

THERE is a right and a wrong way to cut roses. If the cut is not made correctly the blossom-producing properties of the plants may be seriously injured. This applies particularly, of course, to rose plants chosen and grown especially to supply cut-flowers. Such roses will be largely of the perpetual blooming sorts.

When a rose is cut from such a plant only two or three eyes of the current season's growth of that branch should be left on the plant. This should give the roses very long stems. Succeeding blossoms should be cut to the ground. It will seem like destroying the bush to take so much off, but if the object is the production of roses, the cutting away of the surplus wood will simply further the desired end

If the spring pruning has not been sufficiently severe the plant is likely to have long, naked stalks and short stems to the flowers. In such a case only one or two strong leaf buds should be left on the branch when the flower is cut, so as to stimulate as much growth as possible from the base of the plant.

The temptation is great to leave wood where there are two or more buds on one branch, some being small when the terminal one is open. This bad practice can be avoided by pinching off all side shoots after a bud has formed on the end of a branch, thus leaving the stem perfectly clean and willowy.

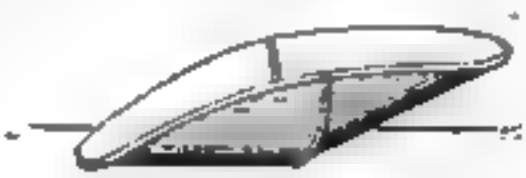
Sheet Metal Working Simply Explained

II.—An easy problem in developing a pattern for a scale scoop

By Arthur F. Payne

Assistant Professor Manual Arts, Columbia College

THE problem for this article is apparently entirely different from that of the periscope. It is true that it is an entirely different object, but the methods used are exactly the same. Pattern drafting is divided into six divisions; namely, (1) orthographic projection (big words, but the easiest of all to draft), (2) parallel lines, (3) radial lines, (4) triangulation, (5) approximation, and (6) templet work. The periscope and the scoop both belong to the second division *i. e.*, parallel lines. If you will examine both drawings you will see that the lines are all parallel, either vertical (up and down) or else horizontal (from right to left).



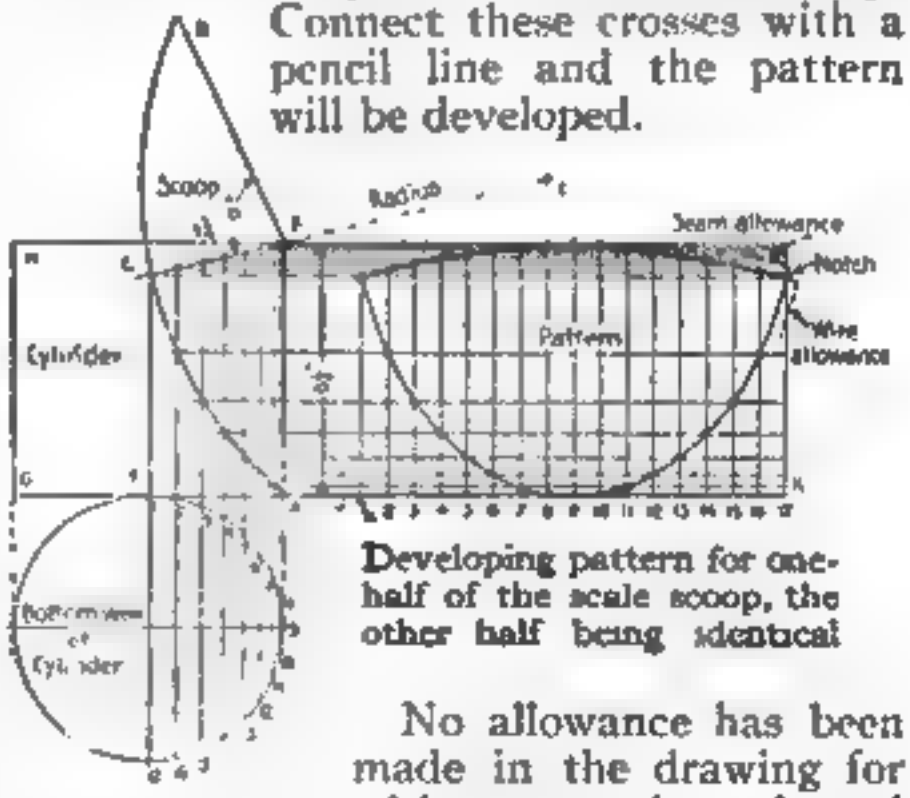
Ordinary scale scoop for drafting pattern

The scale scoop was chosen for this problem because it is apparently a difficult pattern to draft, but in reality it is an easy one. It is only necessary to draft a pattern for one-half of the scoop, as the two halves are exactly the same. Imagine the scoop as being a portion cut out of a cylinder, and the drafting of the pattern becomes simple.

To develop the pattern we must first draw an elevation (front view) of the entire scoop the exact size desired. (The sizes given in the illustration are merely suggestive.) The easiest way to do this is to first draw the line *A–B* the length of one-half of the scoop; draw the line *B–C* at an angle of 75 deg. to the line *A–B*; then draw the line *B–D* at 75 deg. to the line *C–B*. Locate the point *E*. For the size given in the drawing the distance from *C* to *E* would be about 11 in. With this distance as a radius strike the arc *A–C–D*, thus completing the front view of the scoop. Next draw the cylinder of which the scoop is a part. This is done by drawing a line from *C* down to the base line at *F*. The distance *A–F* will be the radius of the cylinder. Only one-half of the cylinder will be required; however it will be easier to understand if the entire front of the cylinder, *A–G–H–B*, is drawn.

Draw the bottom view of the cylinder and divide it into sixteen equal parts as shown. Draw the base line *A–K* of the pattern, and step off sixteen spaces equal to the sixteen spaces in the bottom view. Draw lines from the points upward as shown. Draw lines through the points on the bottom view upward until they cross the lines *A–C* and *C–B*. From these points of crossing draw lines parallel to the base line *A–K*.

With a pencil carefully follow the lines 17 and 1 from the bottom view upward to *C* and then to the right until the cross lines 17 and 1 coming up from the base line *A–K* intersect at this point. Follow lines 16 and 2 upward until they cross *A–C* and *C–B*, then to the right from both points until they cross the same numbered lines coming up from the base line and make a cross at each point. In the same manner follow up all the points from the bottom view and you will have a series of crosses above the base line *A–K* that will outline the pattern for the scale scoop. Connect these crosses with a pencil line and the pattern will be developed.



Developing pattern for one-half of the scale scoop, the other half being identical

No allowance has been made in the drawing for wiring or seaming. A good rule for wiring allowance is to add to the pattern twice the diameter of the wire and four times the thickness of the metal. Another is to allow two and a half times the thickness of the wire. The allowance for the seam will depend on the width of the seam. For a locked seam, three times the

width of the seam must be added to the edges of the developed pattern. This may be added in two different ways. Add a single width on the edge of one pattern and a double width on the edge of the other pattern. The other way is to divide the three-seam widths in half and add the same allowance on each pattern, which would be one and a half times the width of the seam.

Wherever there is a corner in the seam or wire allowance the metal must be cut out or "notched" as shown in the illustration. This is done so that the ends of the wire or seam allowance will come together neatly.

A Pin Inserted in a Cork to Make an Oil Dropper

IN oiling fine machinery, clocks, watches, etc., too much oil is often used. Light oil flows so freely that it is difficult to get just enough out of the spout of an oil-can and to put it in the exact spot where it is needed. A needle inserted in the cork of an oil-bottle will be found to pick up just a drop of oil. This drop will be carried on the point of the needle and can be deposited exactly where desired. Care must be taken not to dip the needle too deep in the oil or there will be more oil clinging to its surface than the single drop needed for a bearing.—W. H. SARGENT.

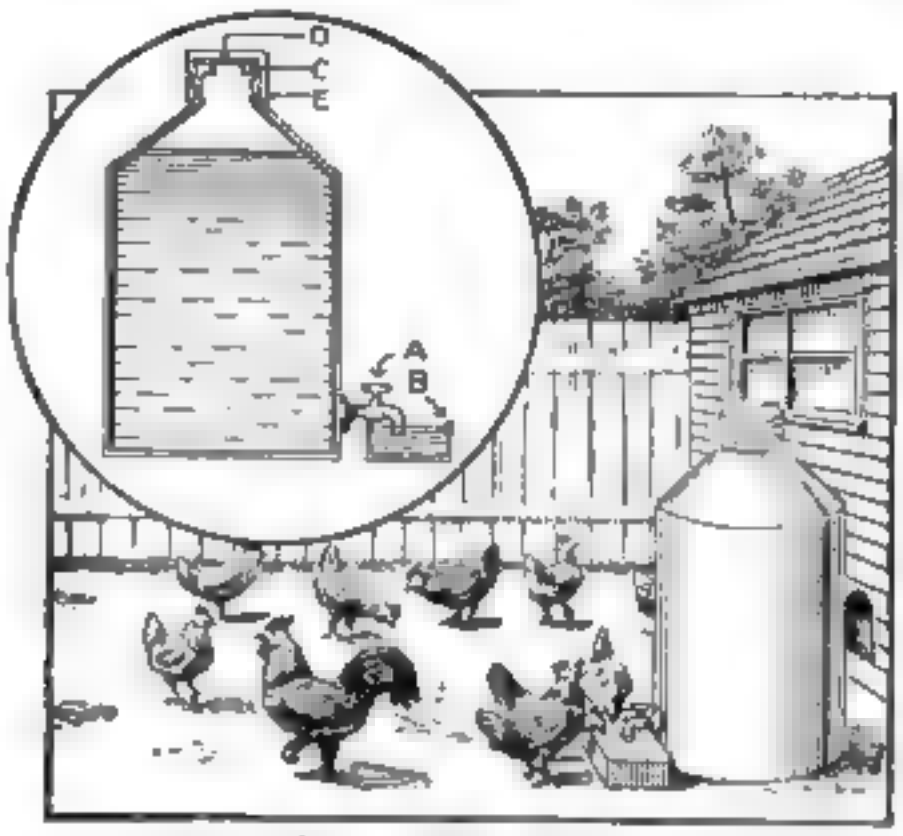
Picking up a drop of oil with a pin

An Automatic Watering Tank for Poultry Yards

MANY types of automatic tanks have been invented to provide fresh clean water for the fowls all during the day. Several of these must be tipped upside down in the process of filling.

The accompanying sketch presents a type of tank in which the water may be poured in through the top. The tank can be made of galvanized iron. A small faucet, *A*, is placed near the bottom so that it will open beneath the surface of the water in the dish, *B*. The cover must fit tightly to make an airtight joint when it is screwed down. To do this a broad shoulder is left at *C* so that the gasket rubber *D* will have a firm foundation.

The following procedure is necessary in filling the tank: Close the faucet, *A*, remove the screw cap, *E*, and pour the water in at the top. The lid is then replaced and

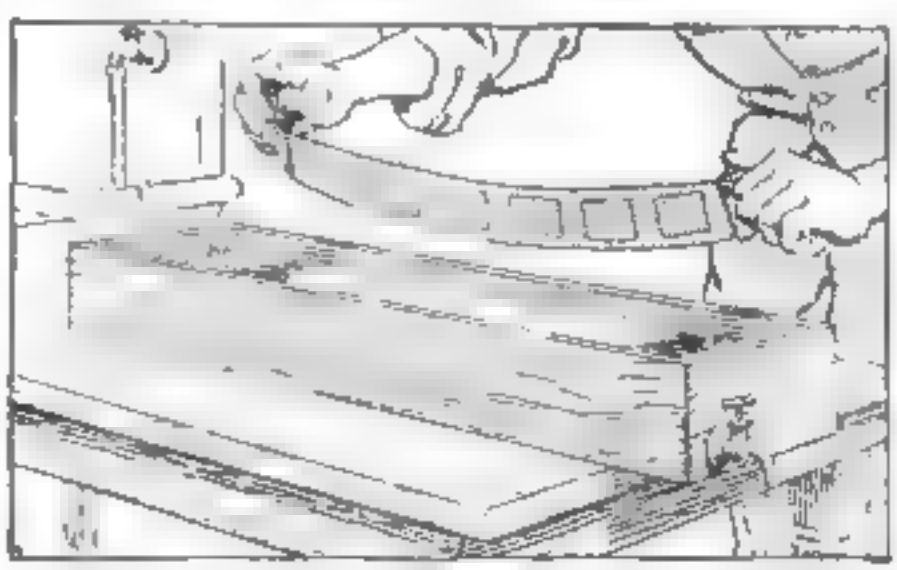


A reservoir from which fresh water is automatically supplied to the poultry yard pan

the stop-cock, *A*, opened. The water will run out until the level in the dish, *B*, comes just above the opening of the faucet.

A Trough for Thoroughly Washing Film Negatives

A SPECIAL trough for washing negatives will be found a great convenience to the photographer who uses films. The trough here illustrated is nothing more than a long, water-tight box, made of galvanized sheet steel, having a drain cock fitted at the bottom of one end and with a small piece of tubing soldered at the top of the other end to hold a length of rubber tubing or



A galvanized iron washing tank for rapidly removing all traces of chemicals from films

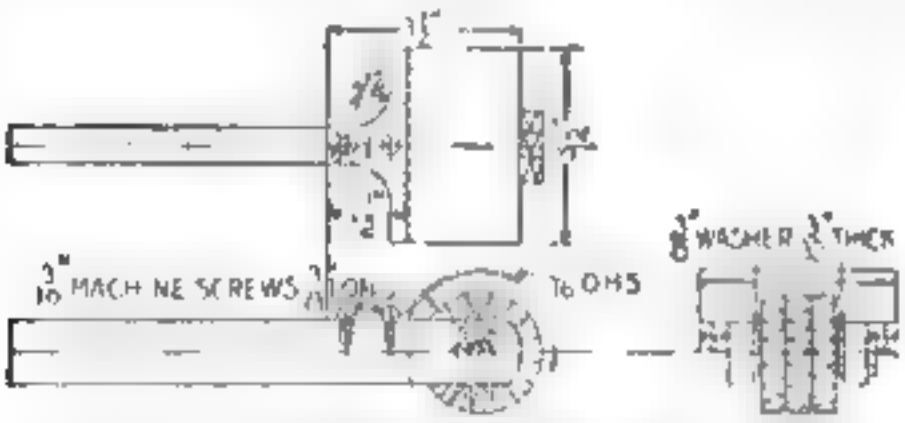
hose for making connection with a faucet. The trough is 40 in. long, 7 in. wide and 5 in. deep.

In use, the trough is placed in a level

position so as to drain into a sink, wash-basin, bath-tub, laundry-tray or barrel. The hose is connected with a cold water faucet, the trough almost filled and the inlet and outlet regulated to maintain a constant depth of water in the trough. The film, with a film clip attached to each end, is laid in the running water, emulsion side up, or, better still, stood on edge where possible. Film pack negatives may be pinned on a stick the exact length of the trough and placed in the running water.

Safety Guard Placed on an Emery-Wheel Dresser

IN the crusade for "safety first" attachments on machine tools, one that is likely to be overlooked is the emery-wheel dresser. This, however, has been taken care of in a very efficient manner in one shop as illustrated. A piece of 1/16-in. boiler plate about 2 in. wider than the



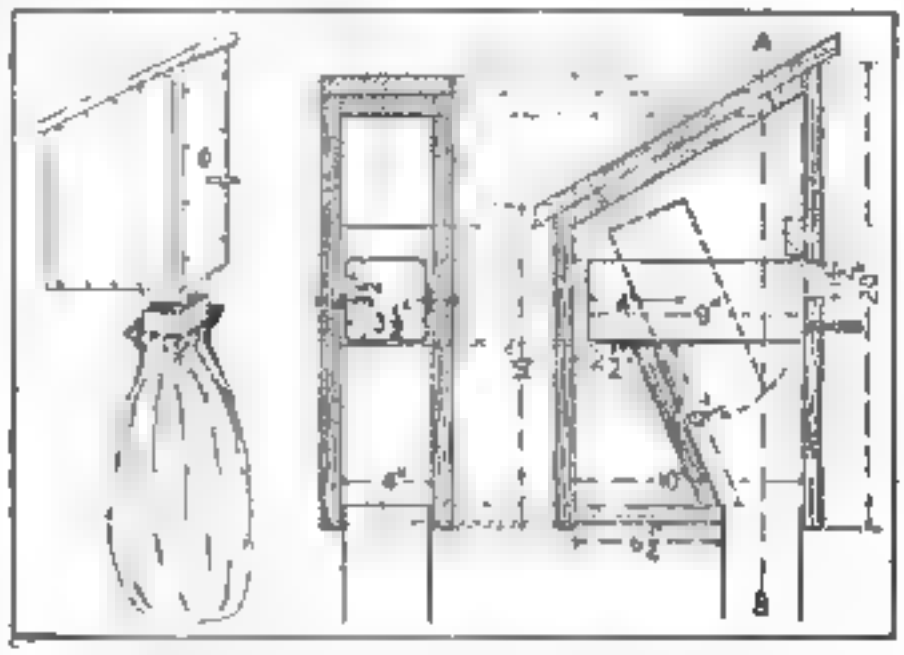
Metal guard attached to the handle to prevent flying particles from striking the eye

cutting wheels of the dresser was bent and fastened with two 3/16-in. screws about 3/8 in. long on the handle of the dresser for a guard.—JOSEPH K. LONG.

A Nest-Box Trap for Catching the English Sparrow

SPARROW traps may be classified, according to the U. S. Department of Agriculture, as nest-traps and bait-traps. Inasmuch as sparrows usually feed in flocks, but approach nest-boxes singly or in pairs, the annual catch of a bait-trap will exceed that of a nest-box trap many times; but during the breeding season the nest-box traps are decidedly useful.

A nest-box trap, as the name implies, looks like an ordinary nest-box. The weight of a bird entering such a trap puts into operation a mechanism which catches the bird and sets the trap for another. There are a number of devices to accomplish this. In designing a nest-box trap one should bear in mind that English sparrows, like other birds, dislike drafty quarters, and that a mechanism delicate enough to be operated by a sparrow's weight is likely to get out of order unless the parts are few



A trap-nest for catching the English sparrow in a bag hung from beneath the box

and perfectly protected from the weather.

Probably the simplest nest-box trap yet designed is the one illustrated. The essential parts of the trap are: a box, a tipping chamber within the box, a down-spout below it and a bag at the lower end of the down-spout. The dimensions of the several parts are given in the illustration. The tipping chamber is made of tin, the down-spout of wood or tin, the box of wood. The roof board is cleated across the ends, and also lengthwise between the cross cleats, for the attachment of the sides, as shown in the side elevation.

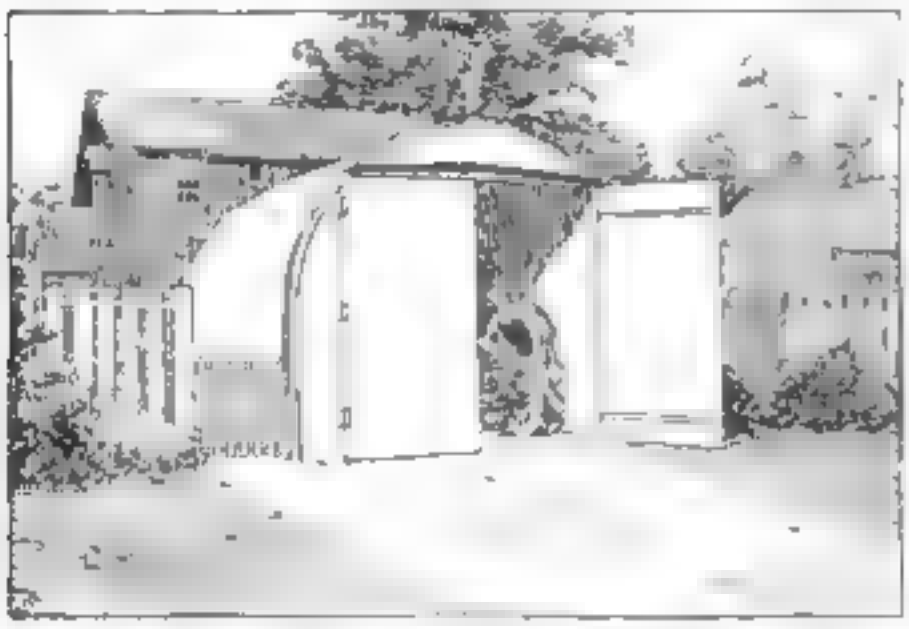
The close weave of a 2-bushel bag makes it suitable for the lower end of the down-spout. One of coarser fabric would allow a draft through the spout and thus detract from the efficiency of the trap. In building this trap the front wall is the last piece to put in place. It is fastened there with screws so that the trap can be easily overhauled. It is a good plan to fasten with shellac a few feathers or bits of hay to the floor of the tipping chamber near the rear end to excite the interest of the sparrows.

Look Over Stored Tires Before Applying Them to Rims

BEFORE using tires laid aside examine them carefully for cuts on the outside, remove tacks and small nails, reinforce any breaks in the fabric inside and lubricate the fabric and inner tube with powdered mica. Apply a thin solution of graphite, shellac and alcohol according to instructions.

A Metal Garage Made from a Discarded Tank

AN opening was cut out in one end of the tank large enough to admit the automobile; then a strip was cut out on the side and the metal bent out to form a

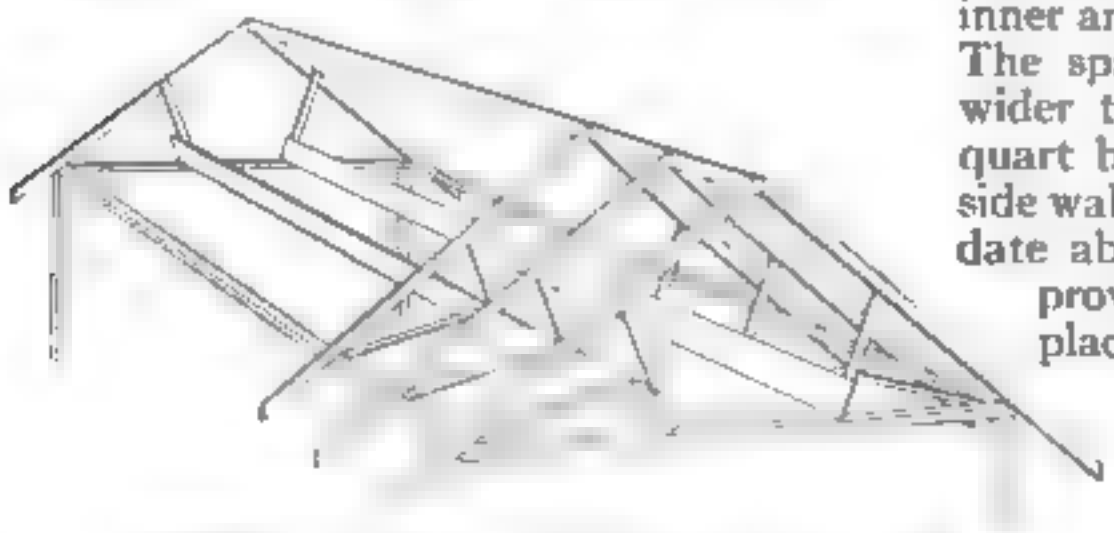


The metal of a discarded factory tank provides an excellent housing for the automobile

covering in the shape of an inverted U. A framework was made of wood and placed on the ground. To this the sides and ends of the tank were attached. The metal which was carefully removed from the end and side, was used for making the doors, which were hung on ordinary hinges rivcted to the metal of the tank. A flashing was attached above the door to keep the rain from beating in back of the doors. A window could easily be placed in the opposite end to furnish additional light if desired.—CHARLES CLAUDE WAGNER

A Cheap and Effective Method of Bracing a Roof

IN many instances the partitions of frame buildings do not allow the rafters to be effectively braced from them, so that



Bracing a roof to provide a space in the center not obstructed with timber supports

trussing is resorted to. This, however, spoils any room directly under the roof. The method illustrated is more effective than trussing, is cheaper, and provides a stronger brace. Also, it does not interfere with the space under the roof.

The trussing consists of two 1 by 12-in. boards the exact length of the distance between the front and rear plates. As many 1 by 3-in. pieces are used as there are rafters. These should be the length of the distance between the bottom edge of the outside rafters and the top edge of the plates at a point half way down the rafter. Nail these on the boards as shown, after having laid out the location of the rafters on their surfaces. Be sure that the ends of the bracing pieces are all in line. Then adjust each board under its side of rafters in an inclined position so that the ends of the braces catch under each rafter, supporting the ends on the front and rear plates of the building, and elsewhere on any partitions there may be in the enclosure. The upper edges of the boards are further braced with 1 by 3-in. strips nailed to the top edges and to the side plates. This keeps the top edges from bulging or moving. It is now only necessary to sight each rafter, slightly moving the braces until the rafter is properly lined and then to secure it with nails.—HENRY SIMON.

Small Closet in Door-Frame Stile for Milk Bottle

THE question of where the milkman shall put the milk bottles in the mornings in order to prevent them from being stolen, upset by dogs or cats, or from smearing the porch or steps has been answered in many ways; but the neatest and best device for the purpose which I have yet seen is a little closet cut out just above the floor in the kitchen, between the inner and outer wall of a cement bungalow. The space between the walls is a little wider than the diameter of the ordinary quart bottle of milk, and a length of the side wall was cut out sufficient to accommodate about four bottles. An inner door is provided so that the bottles may be placed in the little closet and the door shut from the inside. An outer door is also provided so that the milkman may unlatch it, take out the empty bottles, set in the fresh supply and close the door again leaving no trace of the milk visible. This outer door overlaps the opening, somewhat, so that no draft is admitted through cracks.—JAMES A CARTER.

Winning an Athlete's Laurels

IV.—Pole vault and potato races

By Albert B. Wegener

A technical instructor and director of athletics of twenty-seven years' experience

THE pole vault is the most spectacular and at the same time the most exacting of athletic events, requiring strength, speed, and skill. A left-footed jumper should grasp the pole with the ordinary left-hand grasp and the right hand reverse grasp, hands 30 in. apart. For the usual vaulter the right hand grasps the pole according to the following instructions: When the bar is placed 9 ft. high, the right hand is at 9 ft. on the pole; for each foot that the bar is raised the right hand is lowered 4 in. Carry the pole on the right side with the point directly forward and raised a little. Run squarely to the front, avoiding a twist.

The take-off or jumping spot should be directly under the right hand when the pole is planted ready for the spring and the striding marks placed accurately at about 40 and 80 ft. from the stands. These marks must be placed so as to help produce accurate running, as described in the high jump. During the run, look at these marks. Start to run at about 100 ft.

Taking the Jump

Plant the pole lightly by thrusting the end into the hole just before the left foot strikes the take-off. At the same time throw the arms forward up and slide the left hand up close to the right. The arms at this point should be almost straight, the hands above the left foot or a few inches in front of that spot. Any other spot for the take-off will strain the chest or back muscles, and if the arms are too straight or too much bent you cannot rise well. The left foot should be placed upon the take-off a couple of inches to the right of a line drawn directly back of the point of the pole. The hole for planting the point of the pole should be 6 in. toward the runway from a point just under the bar.

In the rise, swing the body forward at arm's length to the right of the pole, facing directly forward. When half-way up to the bar flex the thighs and legs so that they are above the head and the bar. Now straighten out, turn to the left, pull up and push up strongly with the arms. This brings the hips above the bar and facing it in an arched position with thighs flexed. Now push over the bar and release the grasp, with the left hand first, allowing the pole to drop back. Alight facing the bar or with an additional turn to the left.

Training Hints

For several weeks before attempting to vault, practice the following developing exercises: On the horizontal bar, chin several times; then do the same and circle backward over the bar. Circle forward over bar. Hang and raise feet to the bar. Free backward circle. Pull up and shoot over a cross-bar placed 2 ft. in front of and as high as the bar. Practice walking on the hands. Do the hand balance against the wall, then bend and straighten the arms. Practice the rope vault. Practice sprinting and jogging.

When starting to use the pole do not try to vault over a cross-bar for a few weeks, or until the movement is thoroughly learned. Preliminary practice with the pole should be, planting the pole and using the grasp at about 8 ft. high. Plant the pole and swing forward. Plant, swing, and rise. Plant, swing, rise, and pull up, etc. Introduce the bar only when able to do about 8 ft. without it. Do not vault more than ten times a day. Give much attention to massage. If sore and stiff, rest and massage.

Other Styles of Vaulting

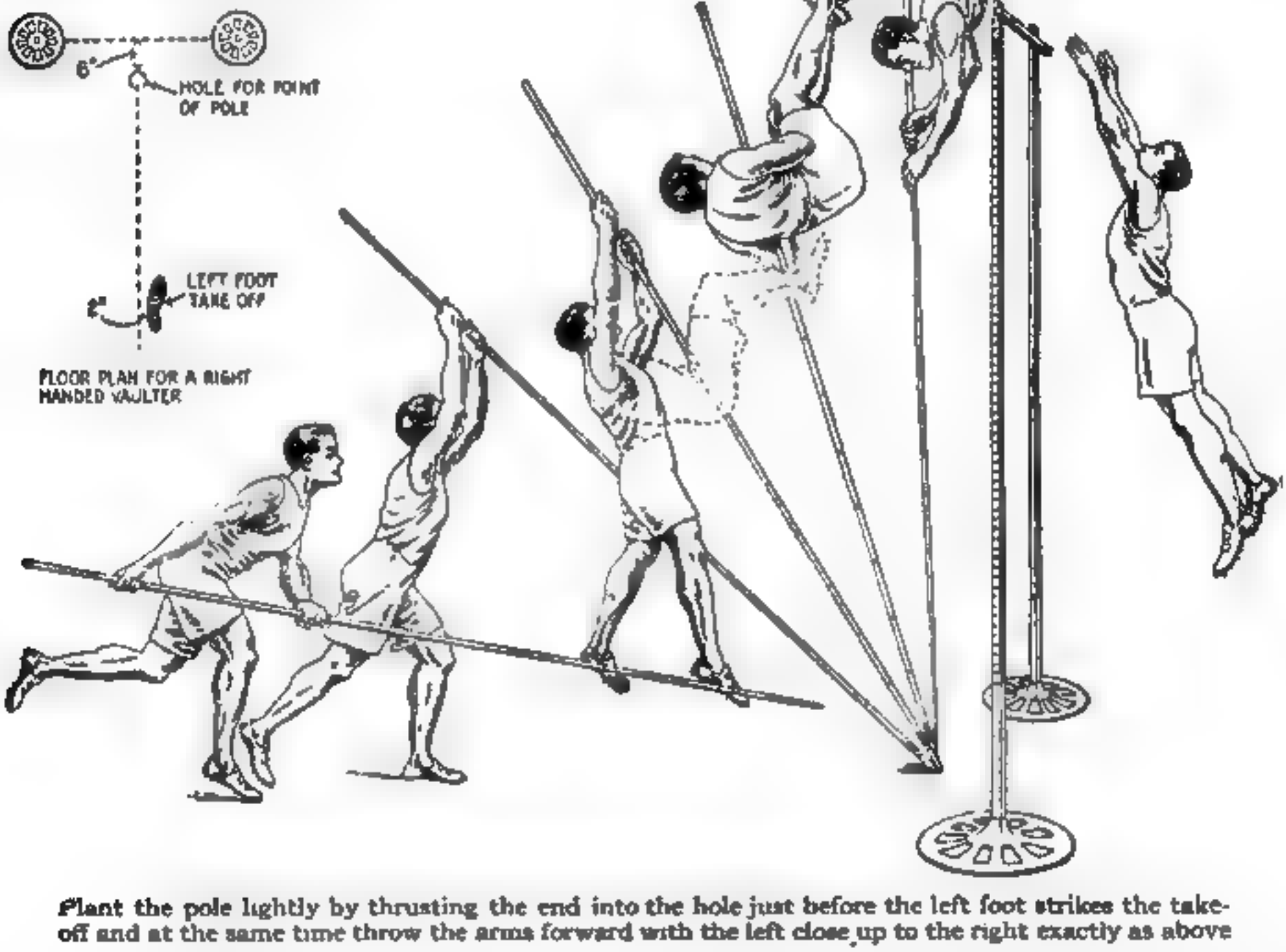
For those who have not the time to devote to learning the exacting shift-hand style, and especially for boys, the no-shift style is recommended. In this the hands are held about 2 ft. apart and neither of them is moved from that position until after the rise, swing, pull up, and shoot over are made. It is impossible to go high with this, but it is much easier and safer than the other style. The Vault for Distance is an event seldom, if ever, now used in

meets, but it would be more appropriate for boys than the vault for height. The action is much like the above styles except that there is no necessity for getting so much of a "lift."

Vaulting Rules

The height of the bar at starting and at each successive elevation is determined by the field judges.

Each competitor is allowed three jumps at each height, and the competitor who fails at the third attempt is disqualified.



Plant the pole lightly by thrusting the end into the hole just before the left foot strikes the take-off and at the same time throw the arms forward with the left close up to the right exactly as above

A competitor may commence at any height above the minimum height. He must, however, jump at every following height until he has forfeited his right to compete further.

The vault is made over a bar resting on pegs.

As soon as a competitor has left the ground for the purpose of making a jump, the jump is counted as a trial.

A line is drawn 15 ft. in front of the bar and parallel therewith, to be known as the balk line, and stepping over such a line, or such line extended, in any attempt is counted as a "balk." Two successive "balks" are always counted as a trial jump.

Any competitor is allowed to dig a hole not more than 1 ft. in diameter at the take-off, in which to plant his pole.

A competitor must not, in the moment that he makes a jump, or after leaving the ground, place his lower hand above the upper one or move the upper hand higher up on the pole.

Poles may have a binding, but must not have any further support for the hands.

If the uprights are moved at all they must not be changed more than 2 ft. in any direction, and not more than one hole may be made by a competitor. The take-off ground about the jump must be level.

The uprights should be at least 12 ft. apart.

All measurements are made perpendicularly from the ground to the upper side of the bar where it is lowest

In the pole vault, if in making a trial the competitor's pole is broken, it is not counted as a trial.

The rules governing the running broad jump also govern the pole vault for distance, except that when the man leaves the ground in an attempt, it is counted a trial.

If the uprights are moved, the field judges should make a re-measurement, because if there is any inequality in the ground at all, changing the uprights may make a difference varying from 1 in. to ¼ in., and a competitor should not be allowed to obtain an advantage in that way.

Indoor Athletic Events

Indoor athletic events are quite as popular as outdoor events, and have the advantage in large cities of being more easily promoted in gymnasiums, large halls, and armories, and of not being subject to the weather. With certain modifications most of the outdoor events can be conducted indoors.

Among the most popular indoor running events are the sprints. These are run either on the main floor or on an elevated track. If run on the main floor the distance is limited by the length of the room. Nothing below 25 yd. is considered satisfactory for "straightaway" running.

When a circular track is used any distance may be run; but contestants cannot, in most places, start side by side on the same mark, on account of the narrowness of the track. For that reason the contestants must run either singly or two may start so as to finish directly on opposite sides of the track, thus allowing the judges to sight across and determine the winner. The most popular arrangement is to have four runners start and finish from separate marks a quarter distance around the track, each runner being timed by a set of watches. This is as close to a real sprint as can be run on a narrow gymnasium track. None of these methods is without objection for narrow track sprinting, and for that reason are never used in important meets. In such meets the sprints are limited to the straightaway on the main floor and nothing less than a half mile is scheduled on the narrow track. But the other methods may be used with profit in closed meets and where absolute conditions are not demanded.

For straightaway sprinting on the main floor there is no difference from outdoor sprints, but for narrow track sprinting the start and "taking the curve" must receive special notice. Toe-blocks cannot be used on such a track. Thus the runner is allowed to brace his rear foot against the foot of another person at the start. In running around the banked curve a sprinter will make the best time by running up high on the outer edge and inclining the weight well in toward the rail

In track events of a half mile or more the contestants start together at or near the same mark, except of course in handicap races. Such races on a narrow track are not always satisfactory because it is almost impossible to pass a runner in the lead without fouling. The only way that this difficulty can be lessened is to insist that the "runner up" must take the outside and the runner ahead keep the inside of the track on the "straightaway" part, and allow no passing on the curve.

Indoor hurdling has been found to be very satisfactory. It should never be attempted on the narrow elevated track usually constructed in gymnasiums. Indoor hurdling, whenever it is scheduled, is always run as a straightaway on the main floor like the sprints. It is seldom possible to have more than two hurdles at the regular distances. It is, of course, possible to place the hurdles about 6 yd. apart and use a single stride between hurdles, thus using more hurdles.

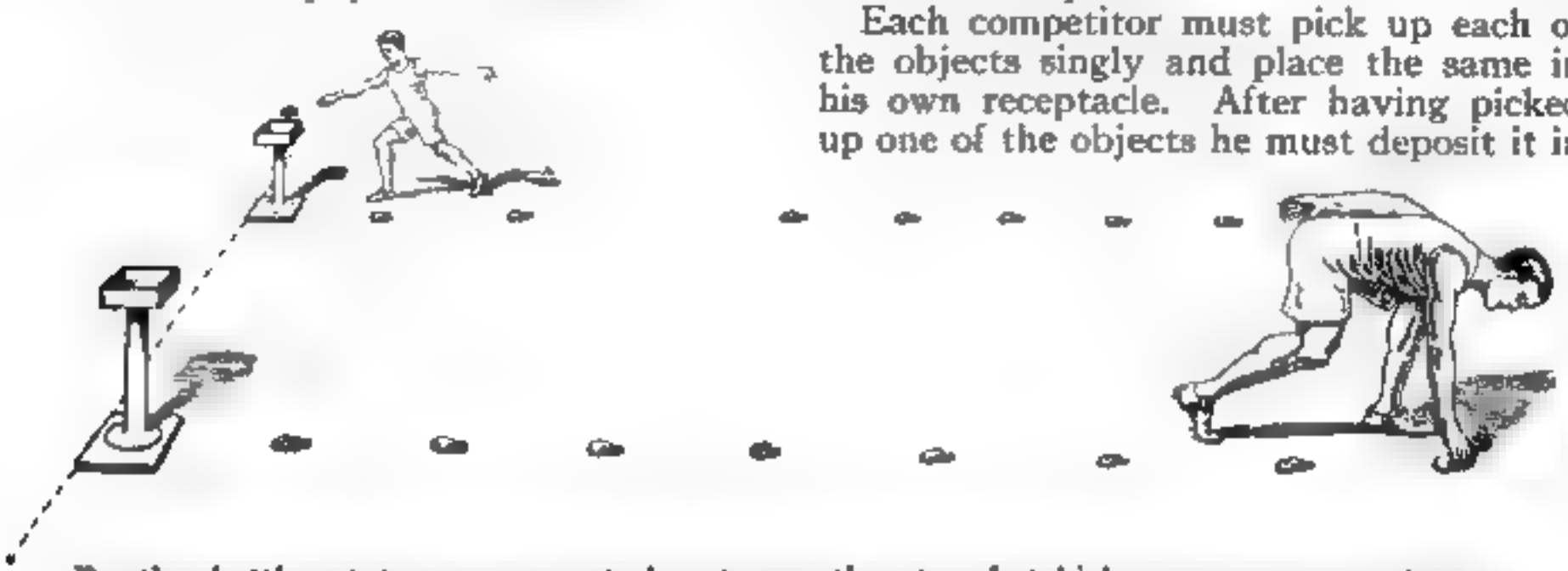
Relay Races in the Gymnasium

Indoor relays, like all other sprints, are never run side by side like outdoor relays, unless run in an exceptionally large room with at least a 220-yd. track wide enough for that purpose. Relay races may be run on the regular gymnasium track, but only two teams can run at a time, and these must start from opposite sides of the track. Such races are popular and should be scheduled in all indoor meets. They are usually made short—one or two laps for each man—because the winning team must run repeatedly. Uprights should be erected on each side of the track opposite the center across which the judges sight on the finish. All runners should line-up on the inside of the track so as not to interfere with the other team as they pass.

The starter should stand at the end of the gymnasium rather than near one of the teams. One judge should be stationed on each side of the track at the finish line. Rules about passing are the same as in other narrow track races, but because fouls are almost unavoidable it has been found better to allow no passing. Such races are

popular as a feature of regular gymnasium class work in which there are many on each team.

Novelty relays are not used in serious meets but are popular as diversions at gymnasium class periods and on other occasions when a jolly contest is in order. Each team has a separate course, consisting of some piece of apparatus placed at each end of the gymnasium. The course of each team is parallel to the others and far enough away so as not to interfere. The kind of races that may be run is limited only by the ingenuity of the director.



For the shuttle potato race a receptacle not more than two feet high or an opening not more than thirty-six inches in circumference is placed upon the starting line for each competitor to fill

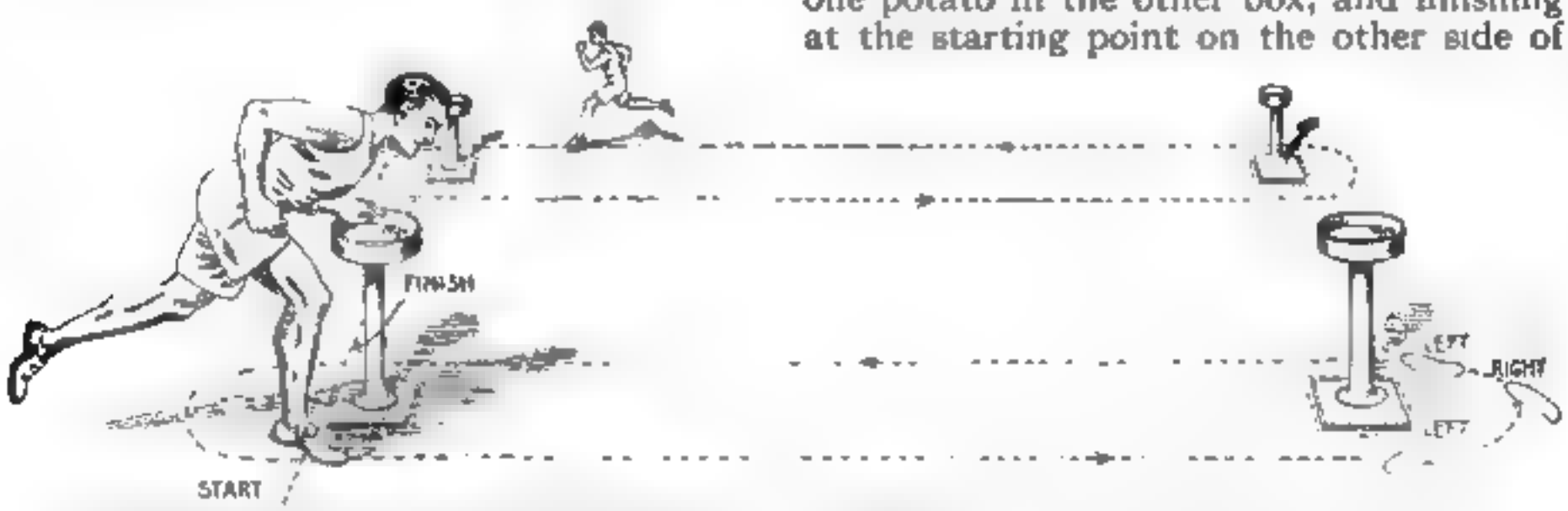
Potato races are runs in which potatoes or any other light objects are carried from one place to another. There are two kinds of these races; namely, shuttle and stadium.

For the shuttle potato race a receptacle not more than 2 ft. high or an opening not more than 36 in. in circumference is placed upon the starting line for each competitor. Upon a straight line drawn from the receptacle at right angles to the starting line shall be placed, at distances of 2 yd., eight light objects, ovoid in shape, the greatest diameter not to exceed 4 in. and the smallest diameter not less than 2 in. The first of these objects shall be placed 2 yd. from the receptacle.

Each competitor must pick up each of the objects singly and place the same in his own receptacle. After having picked up one of the objects he must deposit it in the receptacle before picking up another. After all the objects are placed in the receptacle the competitor must cross the finish line, which is 5 yd. behind the receptacle.

In handicap competitions, the marks are given from behind the starting line.

In the stadium potato races two boxes 4 in. deep, 12 in. in diameter, are set on stands 2 ft. high, for each contestant. The outer edges of these boxes are 31 ft. apart. The runner may start on either side of the box that contains the potatoes, from a line parallel to its outer edge, the starting mark, with one potato in his hand. He runs around both boxes, each time placing one potato in the other box, and finishing at the starting point on the other side of his own box. Grasping either stand in any way, failure to run around both boxes, or a failure to transfer all the potatoes singly from one box into the other shall disqualify the runner.



The runner starts from the starting mark on one side of the box that contains the potatoes. With one potato in his hand he then runs around both boxes, placing the potato in the other box

In case potatoes are dropped or upset by the runner he must replace them without assistance before proceeding with the run. He must not interfere with another runner in any way. The boxes may be fixed to stands, having their bases approximately the same size as the boxes. The stands are not fastened to the floor.

The various distances and number of potatoes are:

60	yards	potato	race	requires	3	potatoes
160	"	"	"	"	8	"
220	"	"	"	"	11	"
440	"	"	"	"	17	"

There are two styles in running the potato races. Some runners keep a steady pace and run in large circles. Others run in a narrow oblong that necessitates slacking the speed on the turns. The latter is more generally used but is thought to be more exhausting than the former.

In making the turns, the runner should face the box and bend well over it, if the narrow oblong style is used. In this it is also well to give attention to the striding. If, as usual, the run is made from right to left, as in track running, the turn should be made with three steps as follows: the left foot should be at the side of the box, then the right should be placed at the end of the box and then the left started on the new stretch.

(*To be continued*)

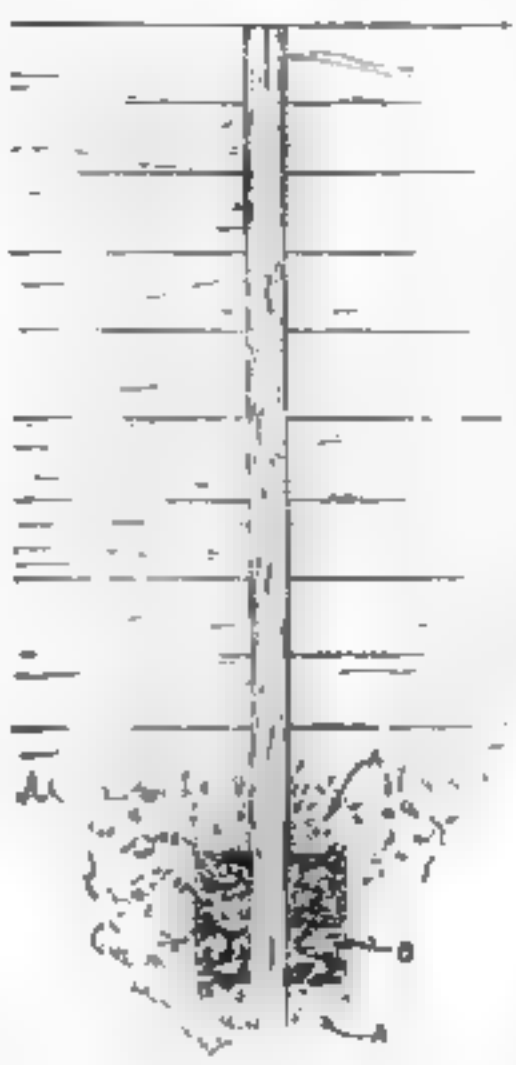
Sticky Fly Paper Used to Keep Insects Away from Poultry

TO keep insects away from fowl in a poultry house sticky fly paper may be used with good results. It is placed sticky side down on the upright parts holding the roosts, which rest on the paper. Do not allow the paper to touch the sides of the building in any place. It is also a help to keep the roosts and parts well greased with some thick grease well rubbed in to fill all the cracks. If there are any night prowling insects in the coop a fair sample of them will be found stuck to the paper in the morning.

Large poultry houses should have metal supports for roosts, with grooves for the ends of the roosts to rest in without fastening. Raise the end of such a roost and put a small piece of fly paper under it, sticky side down. Be careful that the edge of the paper does not stick against the support.—PAUL GREER.

Saving Concrete in Setting Posts in Holes

THE ordinary method of setting a post in concrete is to set the post into the hole and fill in around with concrete. This is wasteful and does not reach the highest efficiency.



The part of the hole between blocks filled in with dirt

A square hole should be dug so that the concrete will have square corners. After placing the post in position the concrete should be poured in until the hole is about one-fifth filled. The concrete is marked *A* in the drawing. The hole is partially filled with wet earth, here marked *B*, leaving room for more concrete. The upper concrete block should be about 50 percent larger than the lower block to offset any difference in the hardness of the ground. There is practically no strain exerted against the ground between the two concrete blocks.—ROBERT W. PHELPS.

Waterproofing Blue Prints and Drawings for Rough Handling

WHEN blue prints are handled to a great extent or when it is necessary to use them outdoors, as in construction work, they often become spotted by water or soiled; which makes the prints difficult to read. Waterproofing them protects them from the water, and makes it possible to wash them off when they become soiled. The waterproofing can be accomplished by dipping the prints in melted paraffin wax and hanging them by the corner to drain.

Another method, not so clumsy, is to immerse heavy blotting paper in the wax and when cold lay the print between two of the sheets and pass a hot iron over them. These processes are applicable to all kinds of papers.—THOMAS W. BENSON.

A Coating Which Gives the Appearance of Stone to Wood

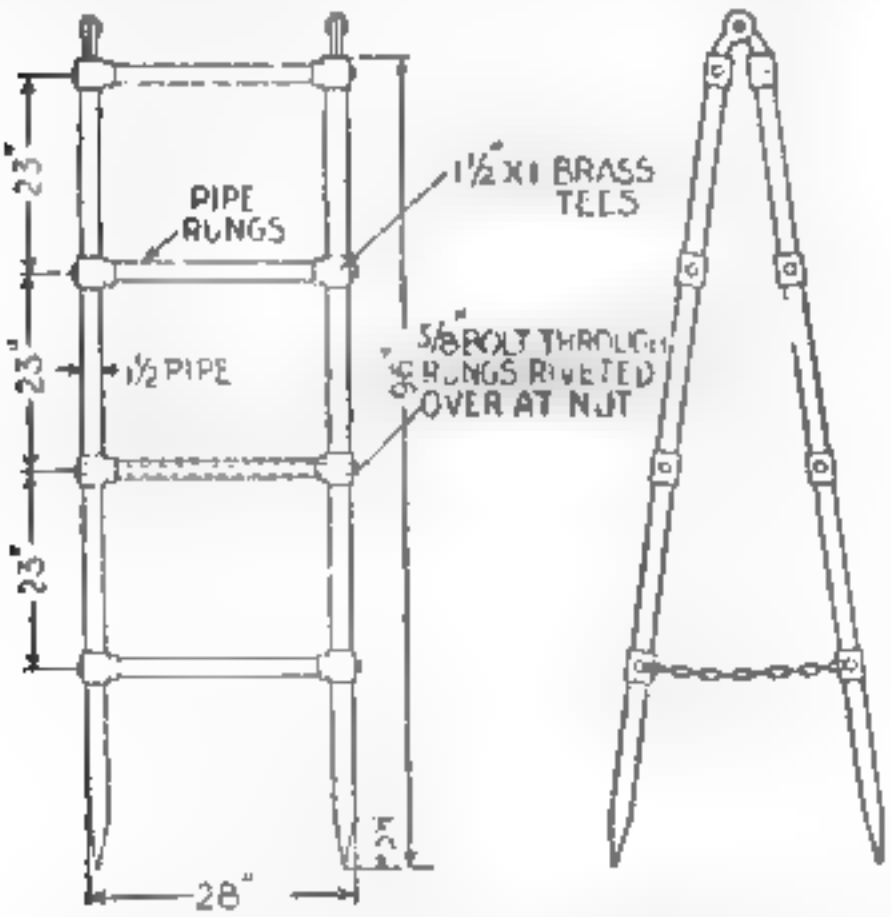
TO make imitation stone for outdoor furniture, sun-dials, flower pots, etc., the following can be used:

10 parts lime
12 parts rosin
1 part linseed oil

Dissolve ingredients thoroughly and apply the mixture while hot to the wood as a coating. The result will be an attractive stone-like appearance that will last indefinitely.—L. E. FETTER.

A Special Ladder for Use in Boiler Shops

THE type of ladder illustrated is especially made for use in boiler and car shops where it is necessary to climb up to moderate heights for doing work. Being of the A-type it can be used like a painter's ladder and a plank can be put between two of them to form a trestle which will accommodate more than one workman. This method of construction makes the best possible ladder—strong, safe and economical. It is built of short pieces of 1½-in. pipe, each about 21½ in. long, which may be picked up about any shop where considerable pipe is used, such short pieces being useless for general work.



An A-shaped ladder made of short lengths of gas pipe and fittings for a boiler shop

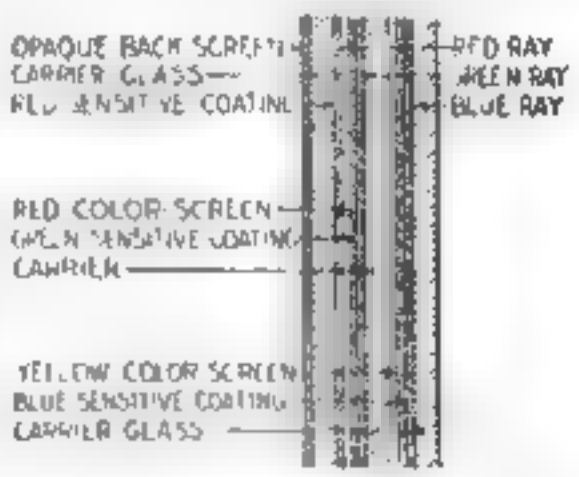
The pipes forming the rungs are 1 in. in diameter. In the making of the ladders illustrated, sixteen 1½ in. by 1 in., brass tees and eight ⅝-in. bolts, one for each rung, were used in each ladder. The parts were hinged at the top and pointed irons were fitted in the lower ends as shown. A chain is used between the parts to keep them from spreading.

While this ladder is very heavy, yet for the usage to which it will be subjected the construction is most desirable and at the same time inexpensive.—JOSEPH K. LONG.

Three Plates and Three Color Screens Used in New Color Photography

IN a recent patent on color photography there is brought out a process whereby three sensitive plates are placed together in such a way that the color screens in in them produce the desired effect on the plate.

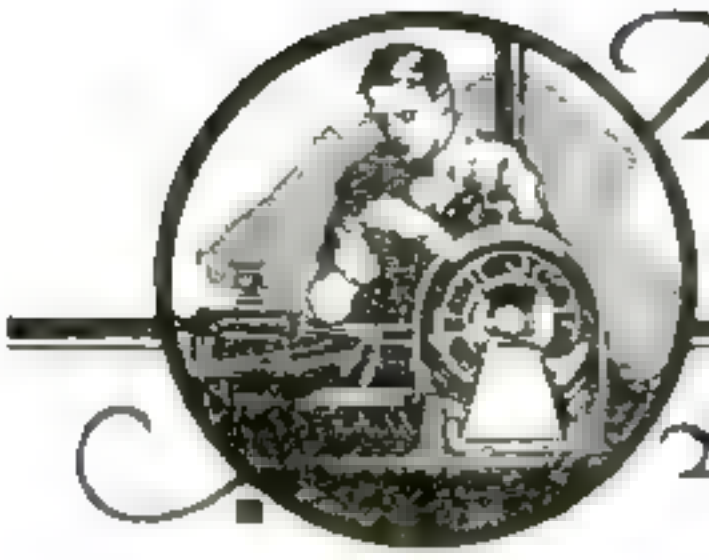
To obtain these results it is necessary to have all plates that are used in sets, sensitized at the same time, so that they will age the same and have the same emulsion.



Arrangement of plates in pack to record natural colors

The ordinary dry plate is sensitive to the blue rays. In making up the sets green-sensitive plates must be used, which are sensitized with a chemical dye. A batch of these plates is divided into two parts, the first portion being coated on the back with opaque substance and allowed to dry, after which they are treated for rendering them red-sensitive. In the meantime, the second portion of the plates, which are already green-sensitive, are superficially coated with a temporary green. Then they are assembled to form a plate pack, and if desired, a blue-sensitive is combined with them. By securing these together they make a unit which may be exposed in any desired manner. After exposure the plates are separated, developed and fixed.

The chemical dye which gives a plate sensitiveness for a given color may be termed a color-sensitized agent and the plate a dye-sensitized plate. The green-sensitizing agent is preferably included in the original emulsion. The illustration shows the sensitive plates and their arrangement in a pack to record the natural colors as the rays fall upon them successively from the camera lens.



The Amateur Electrician

And Wireless Operator

Applying Insulation to Splices Made in Electric Wires

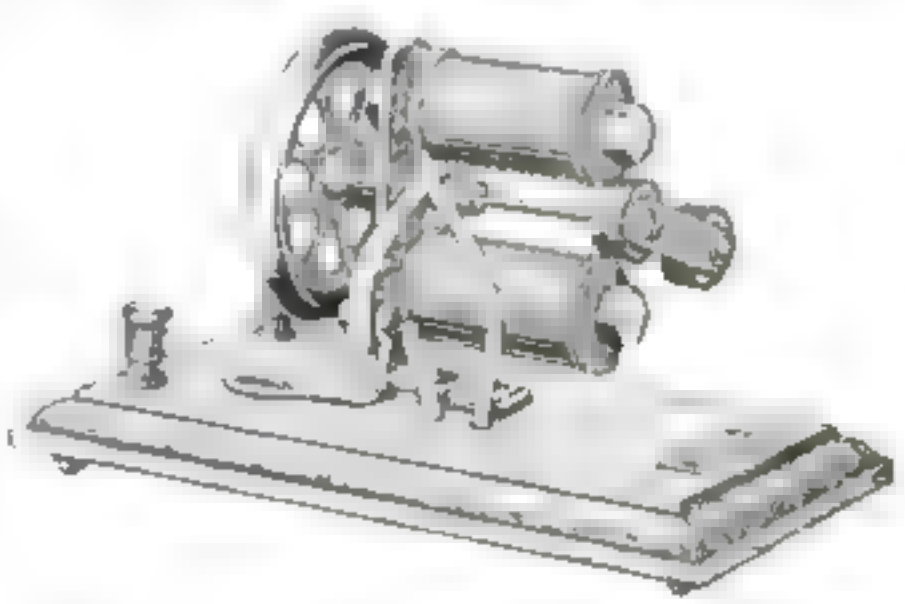
TO comply with the rules of the American Institute of Electrical Engineers, it is necessary to apply a rubber coating over a soldered joint in a wire. One of the best methods of doing this is to lay on the rubber over the splice before it begins to cool from the soldering operation. The thickness of the coating depends on the amount of voltage carried in the line. Cover the rubber insulation immediately with friction tape, drawing it tight, while putting on a sufficient number of layers to stand the wear.

To make a neat covering, cut the friction tape into narrow strips, less than ½ in. wide, and a smoother joint will be the result after the wrapping. If this is done neatly and drawn tight enough there will be a noticeable bulge in the joint. This can be easily wrapped with a cord—silk if the case calls for it—then given a coat of shellac. If the proper color cord or silk is selected a joint that cannot be easily detected results.

A Simple and Easily Made Electric Battery Motor

A SIMPLE and easily made motor that will run at high speed with two or three cells of dry battery, or on an alternating current with a transformer, is shown in the illustration. While this motor can be made in any size that will appeal to the experimenter, only one dimensioned drawing is given. Procure two hexagon-head bolts, *A*, 2½ in. long and ¼ in. in diameter under the head, also some thin hard fiber tubing ¼ in. inside diameter to slip over the bolts. Cut two pieces *B*, each 2 in. long, and fit on heads or washers, *C*, about ⅞ in. in diameter, leaving ¼ in. of the tubing projecting at the threaded end. This forms the spools for the magnets. Wind the spools with No. 22 or No. 24 magnet wire in the usual manner having the inside as well as the outside ends come out at the back end of the magnet.

The soft iron standard *D* is about 3 in. high, ½ in. wide and ⅛ in. thick and bent L-shaped at the lower end to form a foot by which it is screwed to the base. In the standard are drilled three holes. Two of these are of the same size to allow the ends of the bolts or magnet core to enter and project on the outside for the nuts, which hold the back ends of the coils in position. The third hole is located centrally between



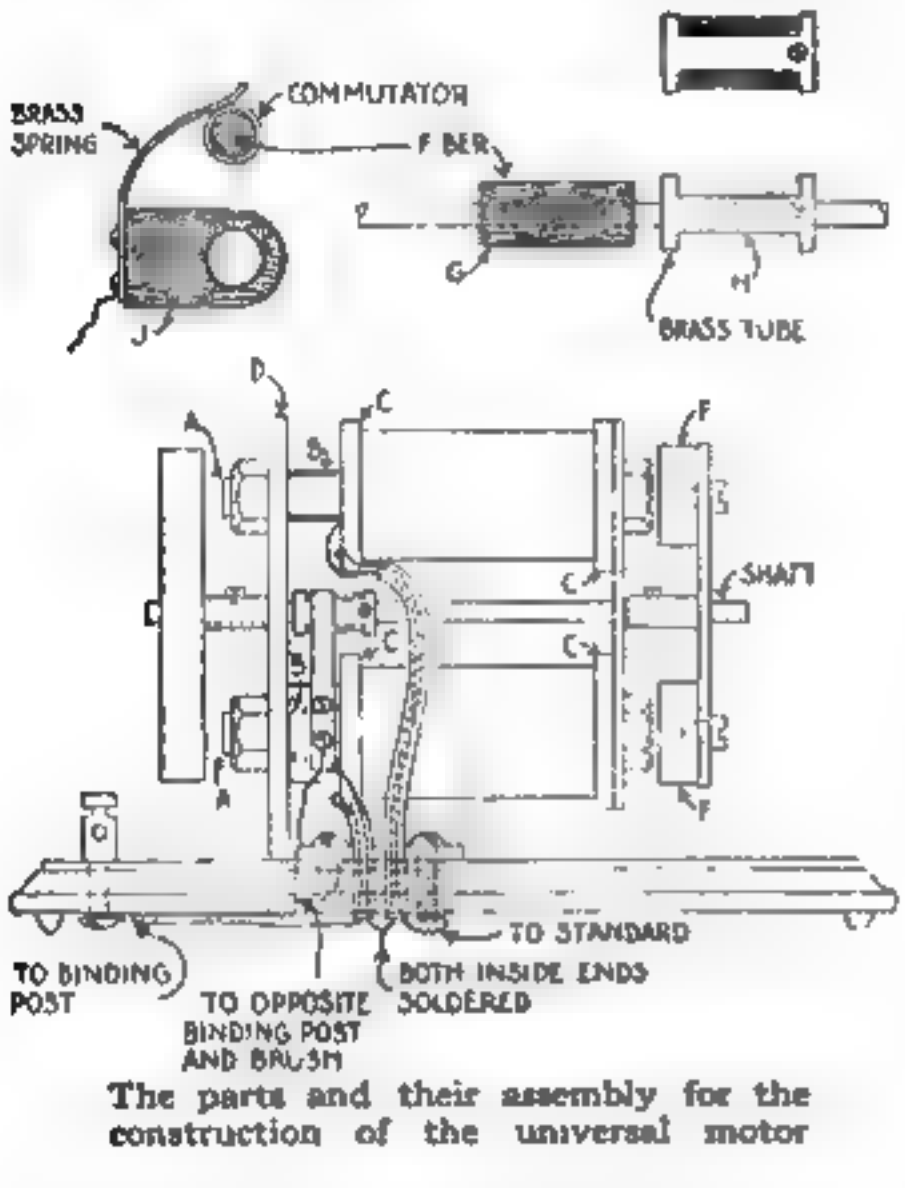
Universal motor that will run on a battery current or reduced alternating current

the other two to accommodate the shaft. The same number of holes and in the same position must be drilled in the brass yoke for supporting the front ends of the magnets and the front bearing. This brass yoke may be a flat strip about ½ in. wide and of a length to cover the front ends of the coils. When the bolts are put through the magnets the protruding ends of the fiber tube will butt up against the back standard and all parts will be held securely in place.

The armature poles *F* consist of soft iron buttons about ⅝ in. in diameter and ¼ in. thick, connected by a strip of brass ⅜ in. wide, having a hub in the center for

fastening it to the shaft. The balance wheel may be made to suit the fancy of the builder.

Before assembling the parts, a commutator must be made and slipped on the shaft back of the standard or between the upright and end support. As it is necessary to have a break in the current for a short



The parts and their assembly for the construction of the universal motor

period a part of the commutator must be insulated from the shaft. This is accomplished by making a base *G* cut from a hard fiber rod which is drilled to slip in the shaft. A brass tube having an inside diameter to fit on the fiber rod is filed as shown at *H*, and when assembled it appears as shown in the illustration on page 147.

The brush-holder for making contact on the commutator is constructed as shown at *J*. The base is made of hard rubber, or fiber 1½ in. long and ¼ in. thick. One end is rounded and drilled to slip over the core or lower bolt between the standard *D* and the magnet end *C*. The thin brass spring makes contact with the metal strips on the commutator as it revolves.

Both inside and outside ends of each coil are brought down through the base in rubber tubes. The inside ends of coils are soldered together. One outside end is connected with the iron standard *D*, and the other outside end with a binding post. The remaining binding post is connected with the spring on the brush-holder.—W. E. Day.

Rebuilding Worn-Out Dry Battery Cells

THE most difficult part of rebuilding dry cells in quantity is the removal of the contents, which consists of peroxide of manganese and carbon powder tightly compressed and covered with pitch. Strike the pitch a sharp blow with a hammer to break it; then dig it out with a pointed tool like that of a screwdriver. Save the pitch and sand in separate receptacles.

The compressed oxide and carbon are also difficult to remove. About the only quick method is to use a twist drill ⅝ in. in diameter, placed in the chuck of a lathe. By pressing the zinc-cylinder of the cell on the drill and boring several holes in the compressed material to within ¼ in. of the bottom, you will break it up so that all of the compound can be readily removed. Save the borings and the crumbled mass. If a small portion is left at the bottom it may be easily removed with the aid of a screwdriver. The material removed is spread out to dry and any lumps found are crushed. The exposure of this material in a thin layer not only permits the moisture to evaporate, but brings about a certain amount of reoxidation of the spent manganese dioxide. As soon as the material has become dry it must be heated to a moderate temperature—about 400 deg. F. will answer, but not to a bright red, as this will drive off some of the oxygen, every bit of which is needed in the renewed cell to act as a depolarizer. During the heating, which may be readily done in a stout iron pan, it must be well stirred. This process will eliminate a very large part of the exciting salts used in the original cell. The heated material must then be spread out and exposed to the air to cool. When cold it is ready to be mixed with the exciting salts and repacked in the original zinc-cylinders.

Almost all the cylinders may be used again after being soaked with hot water for about 1 hour or more. The soaking will loosen the original paper lining and it can be easily removed with a pointed tool inserted between the cylinder and the lining. Finally clean out the interior with a stiff brush and wet sand, or with a wire brush. When the cylinders are aired they are ready for re-filling. Some of the cylinders will be used up and unfit for use again. These may be dissolved in hydrochloric acid to form a strong solution of

chloride of zinc, which is required to make up the exciting mixture. In preparing chloride of zinc, the scrap-zinc should be placed in a large stoneware crock and 3 or 4 lb. of commercial hydrochloric acid poured over it. This must be done outdoors, because the hydrogen gas that is given off is harmful to breathe, and also inflammable. A great heat is generated and the liquid may boil up and make it run over the top of the crock. A small quantity of cold water may be poured in to lessen the chemical action without detriment to the resulting product, which should be left until quite cold before using. It is very important that this solution should contain no free hydrochloric acid, because its introduction into the made-up cell would cause chemical action, and the cell would soon be destroyed. Any trace of free acid is readily dispersed by adding a small quantity of chloride of ammonium in powder form and stirring the liquid until effusing ceases. By this method a small quantity of chloride of ammonium may be introduced without harm. As soon as the solution of chloride of zinc is ready it may be strained through a piece of damp muslin to free it from dirt, paper chips and other matter, and then filtered through a tuft of cotton pressed in the neck of a glass funnel. This will free the solution of any fine iron-deposit or lead that may have been in the zinc, thus aiding the efficiency of the re-made cell. This solution should test 32 deg. Baume. Sal ammoniac, or chloride of ammonium in the crystal form, is then dissolved in the chloride of zinc. Filtered or distilled water is then added and the mixture stirred well and tested to register 32 deg. Baume. The solution is then ready for use.

The carbon-rods and the brass binding-posts and screws must be cleaned and the zinc-cylinder lined with a double thickness of blotting-paper, or blotting-board, cut so as to leave a margin of about ½ in. at the top where it is turned over on the outside. Cut some circular pieces of cardboard, or heavy blotting-board, so that they will fit tightly into the interior of the blotting paper. Press three or four of these down into the bottom of the blotting-paper lining inside of the zinc-cylinder. It is then ready for filling. Just before putting in the mixture pour in some of the chloride solution so as to wet the paper all over, drain it and place the zinc upside-down to drain off the excess liquid. This takes about 20 minutes, for the paper must not be over wet. Then place upon a smooth board about 1¼ lb. of the carbon and manganese powder that has been treated. Add about 3 oz. of the chloride of zinc and chloride of ammonium solution and mix well so that it will hold together when gripped in the hand. It must not be very wet or it will not give the proper amperage. The right consistency is very important. Pour some of the carbon mixture into the paper-lined zinc-cylinder and ram it down hard; insert one of the carbon rods, adjust it centrally, then pack some of the mixture around it and ram it down tight with a suitable strip of wood, hammering it in with a wood mallet. The carbon rod must be tapped down occasionally to prevent it from lifting.

The tighter the mixture is packed the greater will be the amperage when finished.

Cut off the outside edges of the blotting paper and fold the top of it inwards toward the carbon-rod, press it down and see that none of the carbon mixture makes contact between the zinc and the carbon-rod. This is essential as the connection would short circuit the cell. Place all the binding screws in position, test the cell with a suitable battery ammeter and see that the screws of the carbons are tightly fitted. It should give a current of 15 to 22 amperes.

Dry the sand and pack some of it over the top; then melt the tar and pour it on the sand to completely fill the cell to the top. These made-over cells will give an excellent working current for a considerable length of time.

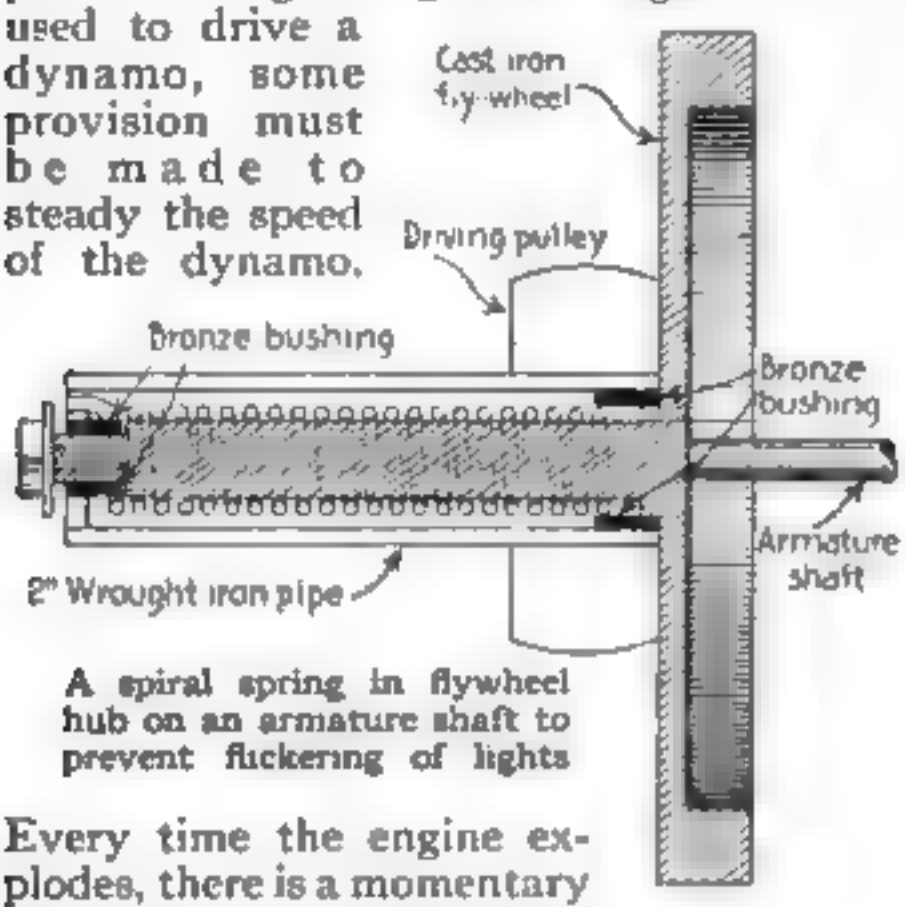
Method of Insulating Secondary "Pies" in Transformers

IN most text-books on the construction of transformers, it is customary to advise the insulating of the "pies" or sections in the secondary winding by means of long strips of empire cloth, wound over and over through the center holes of the sections. This requires a good deal of work on the part of the constructor.

While overhauling a transformer, the writer tried out a somewhat novel method. The core was insulated in the usual manner, with a number of layers of empire cloth, but the "pies," instead of being wound with strips of empire cloth, simply had round disks of empire cloth, of double thickness, between each pair of sections. This gave fully as good insulation, and made access to the different sections easier.

Steadying the Voltage of a Dynamo Driven by Gasoline Engine

THIS problem has been solved in various ways. We are all familiar with the storage-battery system, and being acquainted with this system, realize its expense. If a gas or gasoline engine is to be used to drive a dynamo, some provision must be made to steady the speed of the dynamo.



A spiral spring in flywheel hub on an armature shaft to prevent flickering of lights

Every time the engine explodes, there is a momentary increase in the speed of the dynamo, causing a fluctuation of voltage, and a flicker of the lamps. Special engines with extra heavy fly-wheels have been built for this purpose, which give fair results, provided that the armature of the dynamo has a large moment of inertia. If a flywheel is put on the dynamo, the voltage fluctuation is lessened, but this induces belt slipping, and hence loss of power. Specially built electric lighting engines are expensive, and for small plants of from one-half to two or three kilowatts give but little satisfaction.

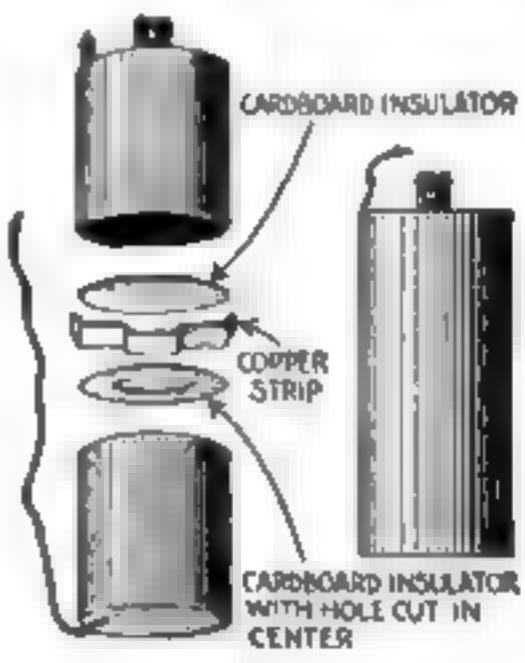
The writer has obtained satisfactory results in a one-kilowatt plant by using the spring flywheel arrangement shown in the diagram. The belt from the engine drives the pulley on the flywheel which is fastened to the pipe. The pipe in turn twists the end of the helical spring. The other end of the spring is fastened to the flywheel. In this way the impulses from the engine are spread over a longer interval, and the tendency is for the dynamo to run at a constant speed. The whole spring is packed in grease, so that there is but little loss of power from friction. Belt slipping is avoided by the freedom of motion of the pulley and pipe. The momentum of the dynamo flywheel tends to keep the speed of the dynamo constant while the engine is slowing down on the compression stroke, and likewise while the engine is on the power stroke, the spring operating as an elastic medium between the driving pulley and the flywheel.

The spring must be made of steel of exceptionally good quality, on account of the rough usage to which it will be exposed. I used a No. 10-gage spring steel wire. This wire was made up into the form of a coil spring and then tempered. A spring was tried which was made of spring steel which had been tempered before it was made into the spring. This spring lasted but a few hours, after which time it was distorted beyond usefulness.

The results with the spring were compared with those without the spring, by first running the machine with the pipe clamped fast to the flywheel spindle, and then running the machine with the spring free to operate. In the first case there was a variation of between three and four volts upon each explosion of the engine; in the second case this variation was reduced to less than one volt, the plant operating at 110 volts. The power losses arising from this arrangement were negligible.

Increasing the Voltage of a Dry Battery

OFTEN a battery of dry cells will fall in voltage or become reduced in pressure because some of the cells have polarized, consequently the current is not sufficient to operate the ignition of an engine or to perform its duty. Such an occurrence is likely to prove very annoying. In emergency cases the voltage can be increased temporarily by taking a good cell from the set, cutting it in half and then making the connections as shown. Slip the container out of its casing to make the cut and connections, then put the two parts back so that the cell will have the same appearance as before. This reduces the ampere hours, but it bridges over the difficulty.



A good cell cut in half to produce more voltage

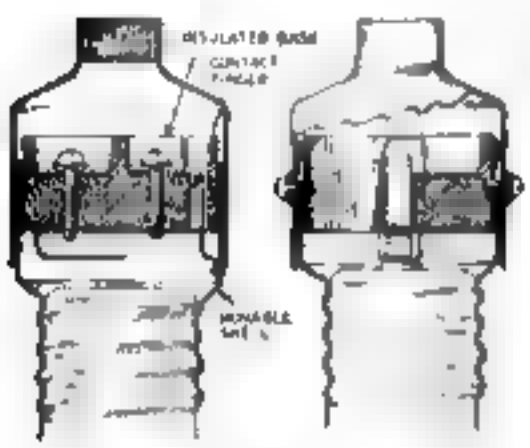
Keyless Lamp Socket for Switching Electric Currents

THE well known key socket for electric lamps requires at least thirty separate and distinct pieces, the assembling of which is an important item in estimating the cost of production.

A new socket has been devised which may be made of less than half the usual number of parts. Instead of having a key the bulb itself serves to switch the current on and off.

Pushing the bulb inward about a quarter of an inch causes a spring finger to snap into contact to connect one side of the circuit, while the central contact point of the lamp is caused to engage with the terminal of the other side of the circuit, thus turning on the current without a push button or switch lever.

In order to cut off the light, the lamp is drawn back so as to sever the connections, the act of pushing in or drawing out the bulb being far less injurious to the threaded end of the socket, or to the fixtures, than the turning operation of the key.



A part turn of the socket switches the current on or off

The drawing shows the socket made of two parts, the lower end, which is threaded to receive the lamp, being adapted to slide within the upper portion that is attached to the fixture. An upwardly-projecting spring finger, the lower end of which is attached to the inside of the lower shell, has its V-shaped upper end normally resting within a recess formed through the insulating material, so that when the bulb is pushed upward the V-shaped end is caused to snap over and engage with one terminal, while a spring finger on the opposite side of the insulating block contacts with the central terminal of the bulb

It will be observed that by this arrangement both terminals are out of the circuit when the electricity is cut off. By loosening the two screws which hold the shells together the entire working parts may be withdrawn, together with the insulating block, affording a convenient and readily accessible means for attaching or repairing the wires.—J. S. ZERBE.

Curious Circuit for Audion On a Wireless Set

IT has often been said that it is not possible to use an audion bulb in connection with a simple double slide tuner. But experiment has proved that a hook-up may be tuned very closely

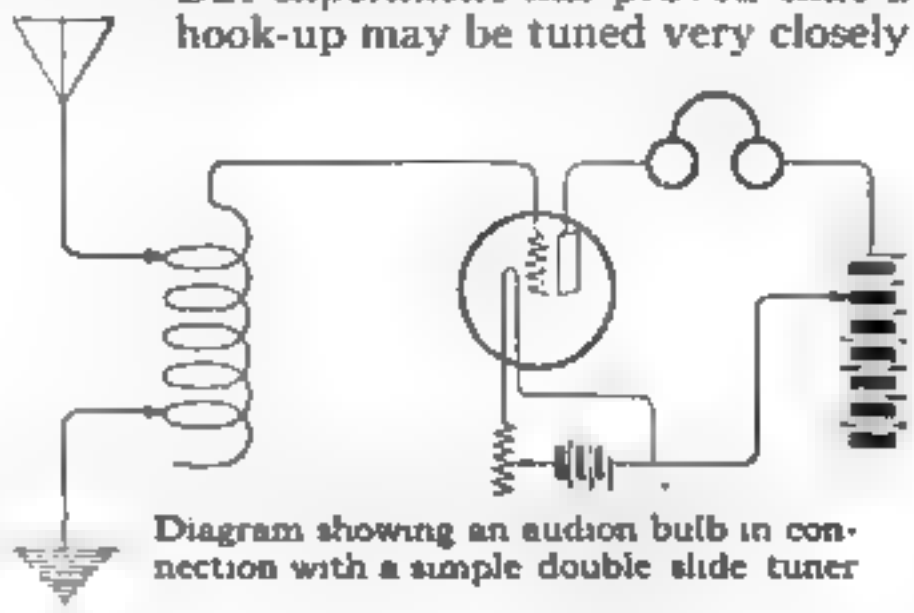


Diagram showing an audion bulb in connection with a simple double slide tuner

and accurately, the strength of signals from all stations being much greater than when the same audion is used with a receiving transformer. On a single-wire aerial 50 ft. high and 150 ft. long, the time signals from Arlington were received over 500 miles under all weather conditions. As will be recognized by those familiar with vacuum bulb circuits, the arrangement shown is very different from the normal arrangements on the usual wireless set.

Conversion of Kilometers to Nautical and Statute Miles

WIRELESS telegraph transmission distances are often stated in kilometers, nautical miles or statute miles. To convert the number of kilometers to nautical miles, multiply by fifty-four and point off two decimal places. To convert from kilometers to statute miles, multiply by sixty-two and point off two places. If the distance is given in statute (or land) miles and you want it expressed in kilometers, multiply the number of miles by 161 and point off two decimal places.

An Experimental Wireless Aerial Made of Zither Strings

WHILE experimenting with several different types of novel aerials I found that by connecting together all the strings of a zither and substituting it for the aerial with an inductive coupler, fixed condenser, silicon detector and a pair of 2000-ohm telephones, I could hear a number of local stations very clearly.—H. DROBE.

The Effect of Electricity and Music on the Human Organism

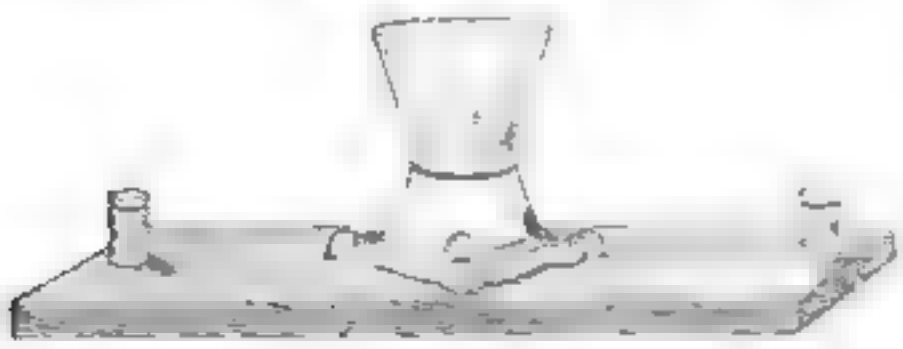
THE effect of music upon the human organism, whether calming, exciting or otherwise, can be reproduced in a remarkable manner by means of electric currents. Dr. M. Dupont is responsible for much of the successful research in this direction and has obtained results that are not only interesting but of probable educational and medicinal value. Music consists of sound vibrations at certain regular intervals. For a high note the vibrations are very rapid, while for a low note they are slower. To produce musical effects by electricity the alternating current is employed, made up of periods, the frequency of which corresponds with the number of vibrations of the sound; that is to say, with the pitch. Upon passing the alternating current through the body in the form of a mild shock an effect is produced similar to the physical thrill of appreciation for a musical performance.—H. J. GRAY.

To Prevent the Ears from Perspiring When Using Telephones

NO doubt the wireless operator has often had the annoying experience of perspiring ears. This inconvenience can be easily overcome in the following manner: Take a small piece of paper slightly larger than the receiver and place it between the receiver and the ear. I have found this to stop all perspiration without impairing the hearing.—W. T. DERR.

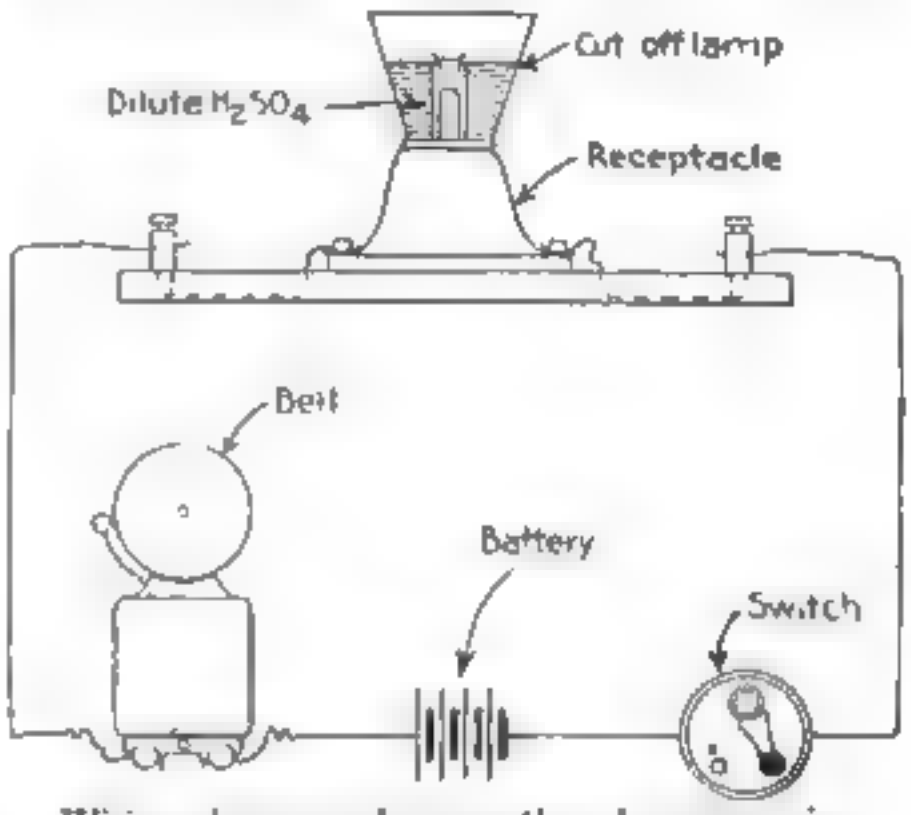
A Rain Alarm Made of a Broken Electric Globe

HOW often the rain pours into a window at night and we know nothing of it until we awake and find the floor and carpet damaged! This can be avoided by installing a simple rain alarm which will ring an



The electric lamp socket on a wood base and the connections with the binding posts

electric bell. To construct such an alarm proceed as follows: Remove the upper part of a carbon filament lamp by winding a piece of cotton string around the lamp just above where the platinum wires come through the stem. Saturate the string with kerosene, applying a lighted match, and, while the glass is hot, dip it into water.



Wiring diagram showing the alarm gage installed in a battery circuit for ringing bell

Screw the lamp into a porcelain receptacle mounted on a board. Make connections with a bell and two dry cells, as shown. Then place the lamp outside the window and fill almost to the platinum tips with dilute sulphuric acid. When a few drops of rain fall into the lamp, the solution, which is a good conductor, will cover the platinum tips and form a circuit, and thus ring the bell. The switch should be put near the bed where it can be turned on and off conveniently.—WM. WARTHEN.

Mounting Tinfoil on Glass Condenser Plates

A GOOD shellac for fastening the foil to the glass in transmitting condensers may be made by dissolving as much powdered rosin as possible in 1 oz. of turpentine and thinning the mixture by the addition of ½ oz. of alcohol. Only a very small amount of rosin will be needed.

About three drops of shellac should be put in the center of the surface of the glass and rubbed around well. Place the foil on the glass and roll it fast with a photographic print roller. The foil must be placed on at once as the mixture dries quickly. When this varnish is used the plates may either be stacked or made into an open rack condenser. If plain turpentine is used the foil will not stick so well and consequently the plates must always be stacked.—SAMUEL W. HUFF.

How Germany's Secret Service Wireless Stations Are Being Weeded Out

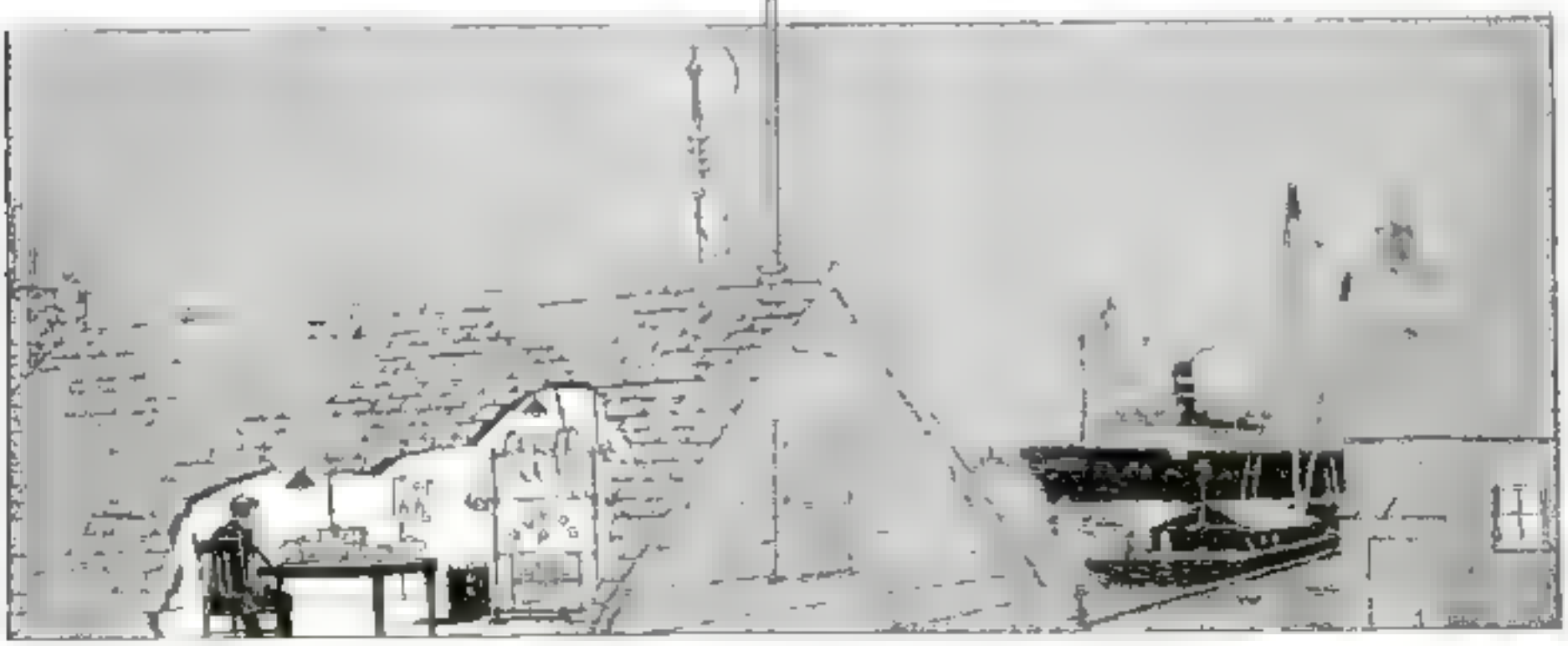
THAT there are secret service wireless stations of Germany in and about our large cities and important harbors, there is not the slightest doubt. At the time the merchant submarine "Bremen" was to arrive from Germany, it will be remembered, German agents prepared moorings for her at New London, Connecticut. Neither the Government wireless stations nor our commercial stations received any communications from this submarine. Evidently, secret stations, whose messages we could not hear, must have kept in touch with her.

These stations, we can rest assured, have not dismantled, but are working now. They await only the opportunity to report the sailing of a Europe-bound ship to a submarine waiting offshore. Unquestionably, such a menace must be weeded out. Our Government has not been idle. According to reliable information, it has already located several of these stations. The problem is not an easy one, and is one entirely of wireless engineering.

William Dubilier, one of our most prominent experts, believes that the Germans manage to keep their antennas concealed by stringing them inside high non-metallic structures; as, for instance, a hollow wooden flagpole. Though but one wire could be strung inside a flagpole, what would be lost in antenna efficiency could be partly compensated for by the increased power of the station. Of course, these spies would not be compelled to use an aerial at all. They could use a close circuit system having two grounds. But this is not likely. The other method is more efficient and lends itself to better selectivity.

From the antenna concealed in the flagpole, the spies could run the aerial lead directly through the roof and into the garret of the building, without exposing it. These instruments, we can take it for granted, are the best that German money can buy. The operators obtain their unusual selectivity probably by the use of a double heterodyne or ultra-ultra system. That is, they superimpose a number of oscillation circuits one upon the other between the exciting transformer and the aerial and ground connections. The various ways in which each of these many circuits can be tuned are almost unlimited. The waves such a system would send out could be efficiently received only by a receiving system of similarly complex configuration. The usual station which has not these superimposed circuits could not receive the signals distinctly.

These facts give some idea of the task our wireless engineers are up against. First, they must obtain a circuit which will receive these secret signals—a most difficult task which would involve the finding of the exact number of the superimposed circuits and the exact configurations! Second, they must locate the stations with some sort of direction-finder using this type of circuit. The methods used with these finders would then be similar to that explained in a previous article on the direction-finder, on page 232 of the February 1917 issue of the POPULAR SCIENCE MONTHLY.



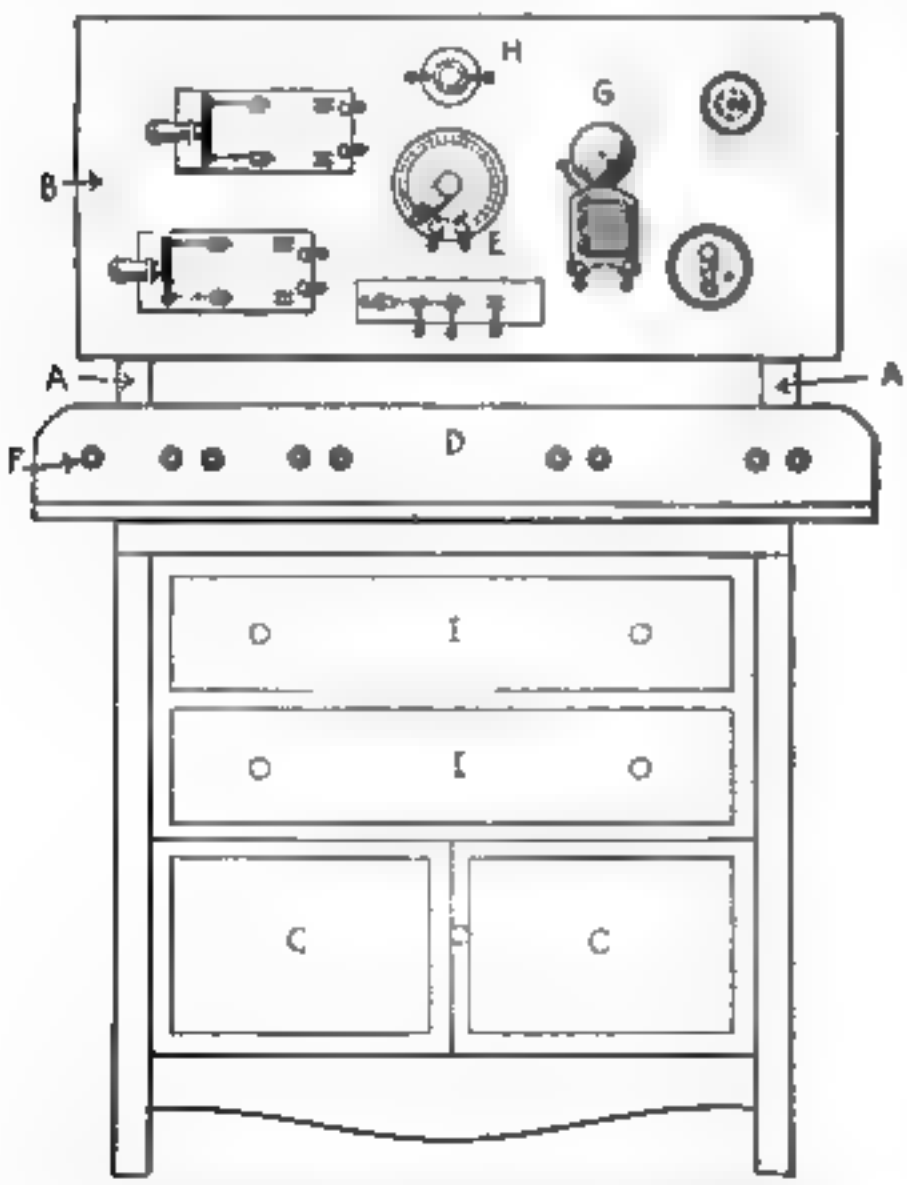
The Germans conceal their aerial in the hollow of the flag pole. Their complex waves can be received only by submarines and other stations fitted out like themselves

Electric Experimenting Table Made from an Old Commode

AN old commode such as is very often discarded or sold for little or nothing can be very easily and cheaply transformed into a high class electrical experimenting workbench in the following manner. First procure a nice smooth board and nail it firmly to the two uprights *A*, which are found on nearly all old commodes. This forms the switchboard *B*, upon which all switches, rheostats, meters, etc., can be conveniently mounted.

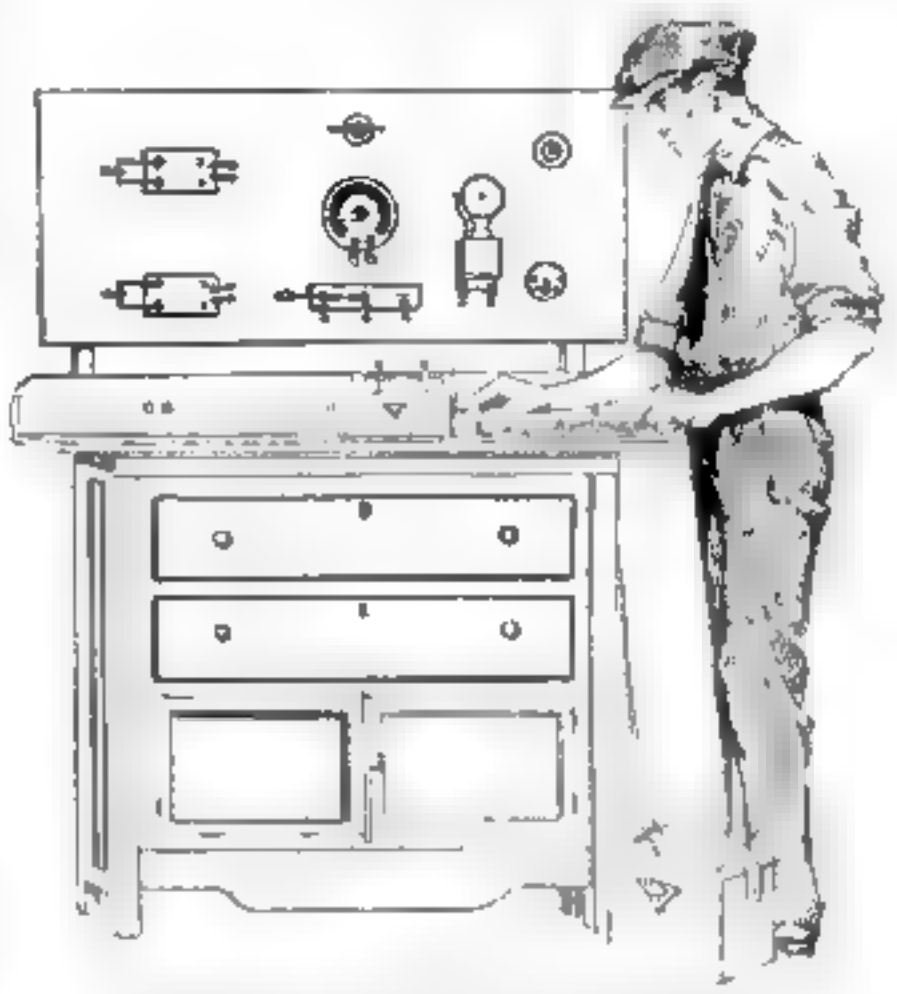
In the accompanying drawing, a very convenient arrangement is shown. The dry cells, storage battery, or transformer is placed in the little cupboard *C*, at the bottom of the stand, from whence the two wires lead to the switchboard and are there connected as the user may see fit. All the wires are run behind the two uprights *A*, so as to make all the wiring invisible, which adds much in neatness.

The terminals for connecting motors and other experimental apparatus are placed upon the little back board *D*. Old battery binding posts may be used for this purpose.



A board placed on the towel hanger supports of a commode for an instrument board

Each terminal is operated by a switch on the board so that it is not necessary to disconnect a wire in order to shut off the current. It is also very convenient to have one of the terminals connected in series with a rheostat *E*, so that the quantity of



All instruments and tools may be kept in the drawers while the top is used for a table

current can be regulated. A ground connection *F* might also prove handy for various experiments.

A call bell *G* and small electric light *H* can also be mounted on the board. For anyone possessing a wireless telegraph set, this stand is doubly convenient, as the aerial switch can be placed on the board and the instruments mounted directly on the top of the stand, if desired. Innumerable other connections and uses will readily present themselves, depending on the apparatus possessed.

Tools and instruments can be kept in the drawers *I* and thus be always handy and out of the way. A small hand vise can be fastened on the stand if needed. The principal advantage of it all is that everything is conveniently contained in one unit.—J. EDWARD WHITE.

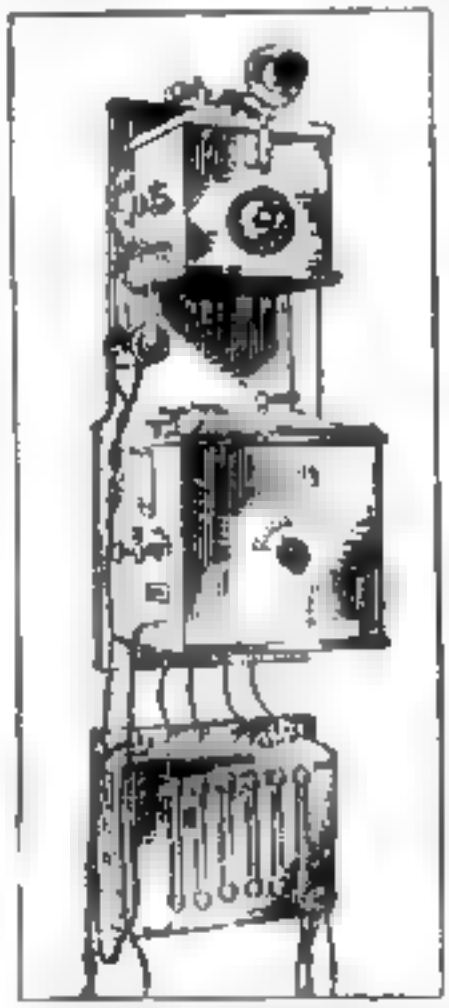
Panels Made Out of Rubber Storage Cells for Radio Apparatus

IN making panel facings for loose couplers or cabinet sets cut up an old hard rubber storage-battery case and use it for the switch-panel facing. When drilling be careful not to apply too much pressure. A plane may be used on this material if great care is taken; but it is very brittle and will break easily. It may be polished with sandpaper.

Japan's Commercial System of Wireless Telephony

ALTHOUGH it is not generally realized, Japan has been one of the most diligent countries in making wireless telephony a commercial possibility. The "T-Y-K" radiophone system which the Japanese have developed is unusual in simplicity and compactness. It contains no very intricate circuits, nor does it use a delicate air-sealed spark-gap, as in other telephone systems. The few adjustments that are necessary can be made by almost anybody, and the spark-gap will work while exposed to the air, without deterioration. These facts have made the system so practical that Japan has already established wireless communication between her important islands by means of it.

The spark-gap electrodes are made of oxide of iron, brass, aluminum, and similar materials which are practically indestructible. The electrode surfaces are small and are placed nearly touching each other, so that the spark-producing potential can be comparatively low. Thus, the voltage of the exciting generator is slightly more than one hundred, though as much as five hundred volts have often been used. As soon as a potential is produced across the gap, an oscillating circuit that is coupled to the gap becomes simultaneously charged. Once a spark jumps across the gap, the natural tendency of both the inductance and the capacity of the oscillating circuit is to send a current from one to the other. The result is that each is rapidly charged and discharged, the current crossing the gap at a rate of about 120,000 times a second, producing one spark with every surging. The surgings in the primary circuit are then induced in the aerial and microphone circuit which is coupled to it. The result is that the aerial radiates its wireless waves, which are modulated by talking into the microphone transmitter.



A complete Japanese T-Y-K installation

But all this depends upon the formation of a first spark which will release the charge of the oscillating circuit. The resistance between the two electrodes—caused by the insulating layers of air and of the oxide formed on the electrodes—ordinarily prevents this. So an equilibrator is used for temporarily raising the potential in the spark-gap circuit. The equilibrator consists of a strong electromagnet which, just as soon as a current begins to build up in it, attracts the armature of a circuit-breaker. The circuit-breaker is sharply opened, and the inductance discharges at high potential, supplying the necessary potential across the spark-gap.

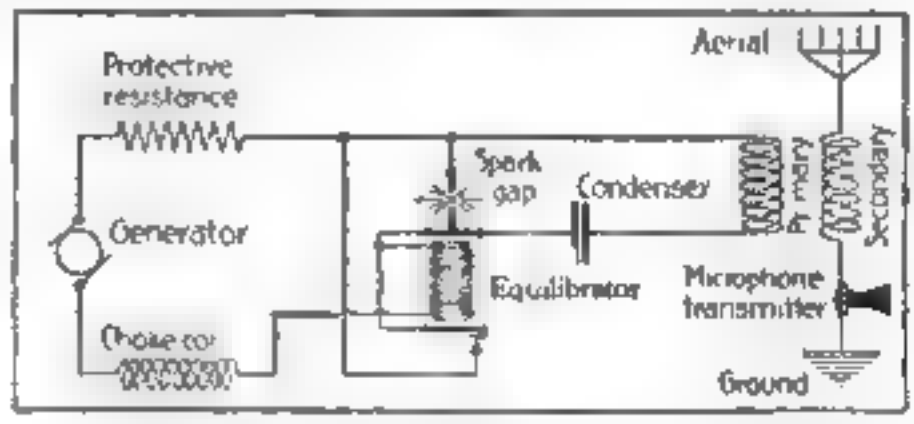


Diagram of connections: The transmitting system uses an air-exposed spark gap. A crystal detector system is used for receiving

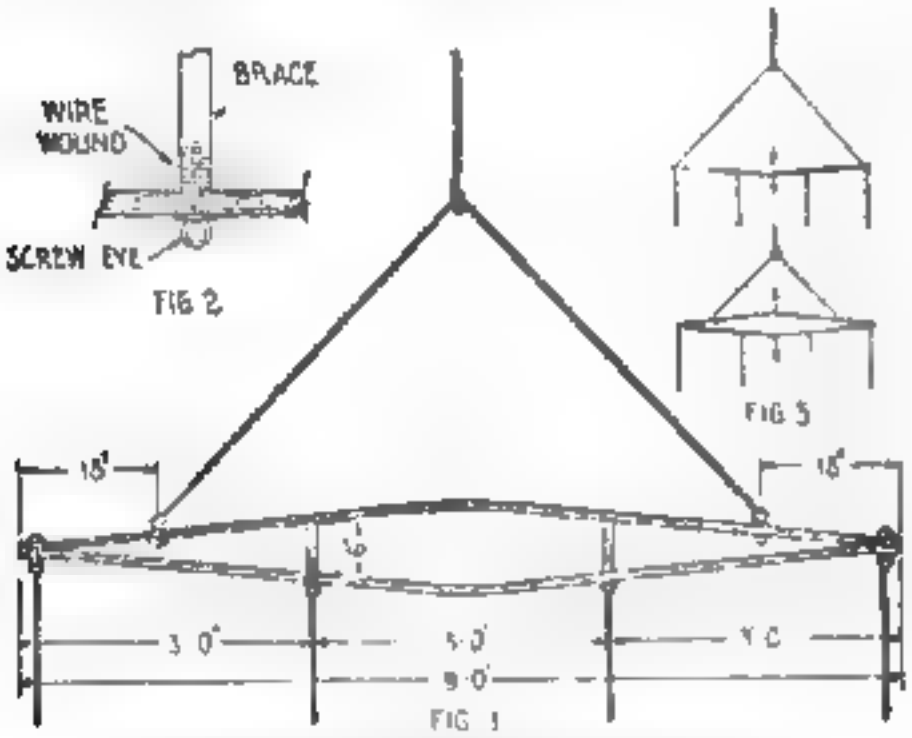
Since the equilibrator works automatically, only the simple adjustments of the oscillating circuits require attention. The waves the system sends out, being of relatively low frequency, can be received by the ordinary crystal detector. Using it, a maximum range of thirty to forty miles has been obtained.

A Crystal Detector Holder for Wireless Apparatus

A SIMPLE clip to hold the mineral consists of a straight piece of brass sheeting with a U-shaped piece of spring brass soldered on at one end. Another and better device for holding the mineral is a reflector from an old tubular flashlight of the larger size. Clean off the enamel and polish up the brass. Fit a piece of wood into the socket and drill a hole in it for a machine screw which passes through into the base of the detector. A large brass washer will be required under the head of the machine screw. Drill and tap out three holes through the side of the cup for the set screws which clamp the mineral. The cup will hold odd-shaped minerals of various sizes and can be turned around at will.

A Trussed Aerial Spreader for Long Wires

A LIGHT and strong spreader is very desirable when the aerial reaches over 200 ft. in length. While bamboo answers the purpose for spreaders shorter than 6 ft., it does not do for longer ones.



A light frame trussed so that it will be strong enough to hold a large aerial

A truss-built spreader fills the conditions admirably. Select two straight-grained pieces of spruce 9 ft. 3 in. long, by 1 in. square and two braces 6 in. long by 1 in. square. The pieces are assembled as shown in Fig. 1. The detail showing how the braces are fastened to the spreader-piece on the side where the aerial wires are attached is seen in Fig. 2. The other ends of the braces are fastened with wood screws. The rope-bridle is fastened 18 in. from each end, to equalize the strain, as shown in Fig. 3. The arrows denote the line of strain. A spreader built with these dimensions is sufficiently large for an aerial 300 ft. in length.—E. R. THOMAS.

Position of Wireless Waves Passing Over Land

WHEN radio waves travel along the surface of the sea, or of any other good conductor, their fronts stand up nearly vertically. When they pass across stretches of poorly-conducting earth, however, the tops tend to gain and the whole wave-front tips forward in the direction of motion. Resulting currents in the surface of the earth cause resistance losses, and the waves rapidly become weaker. This is why it is more difficult to send wireless signals over ground than over salt water.

Cloudy Days Best for Wireless Wave Signals

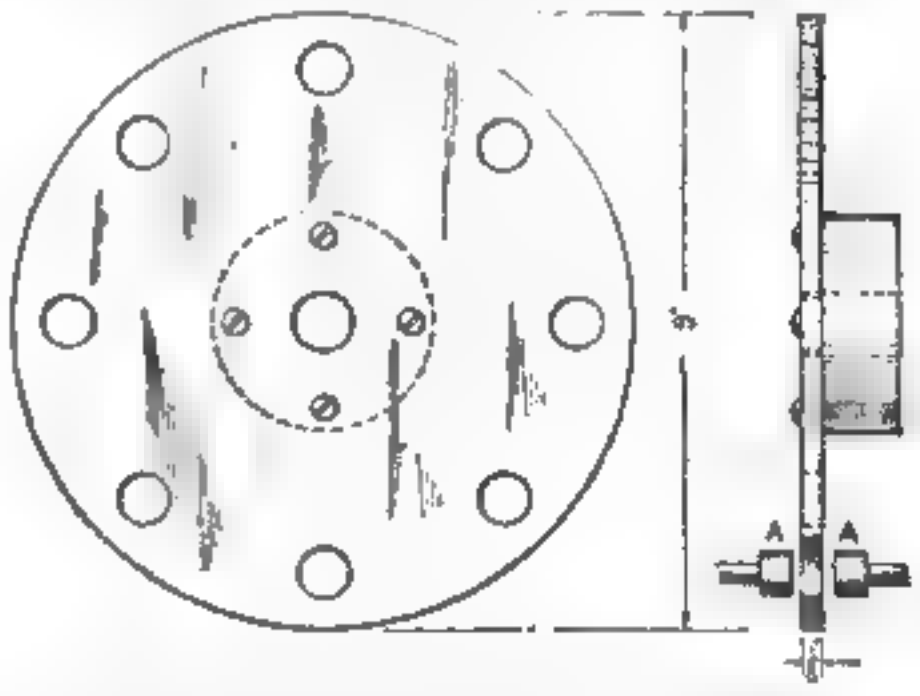
MEASUREMENTS made at the University of North Dakota showed that on the night following a cloudy day signals were received much more clearly than on nights following days of bright sunlight. It appeared that the cloudiness was most effective when it covered the territory lying between the sending and receiving stations.

Improving the Tone of a Test Buzzer Used on Wireless Detector

THE tone of a buzzer used in finding a sensitive spot on the crystal detector can be made high-pitched by inserting a piece of paper, folded four times, between the contact spring and the bar next to the magnet. Also insert a folded piece between the cone of the first coil and the bar.

Simple Construction of a Rotary-Gap Disk

IN the accompanying illustration is shown a new type of rotary-gap disk which will give unusually good results. It is very easy to construct. First procure a piece of ⅛-in. sheet fiber and cut out a disk 9 in. in diameter. With a 4-in. radius draw a circle on this and divide it off into 8 equal



Holes in a fiber disk to allow the spark to jump between the electrodes as it turns

parts. Drill holes on these marks slightly larger than the gap-electrodes and drill a hole in the center for the shaft. Mount the disk on a motor in the usual way with a set-screw or clamp, and mount a stationary gap as shown at *A*. Every time a hole is passed, the gap is permitted to spark. More holes can be added if desired, depending on the speed of the motor.

The Construction of a Magnetic Break Key

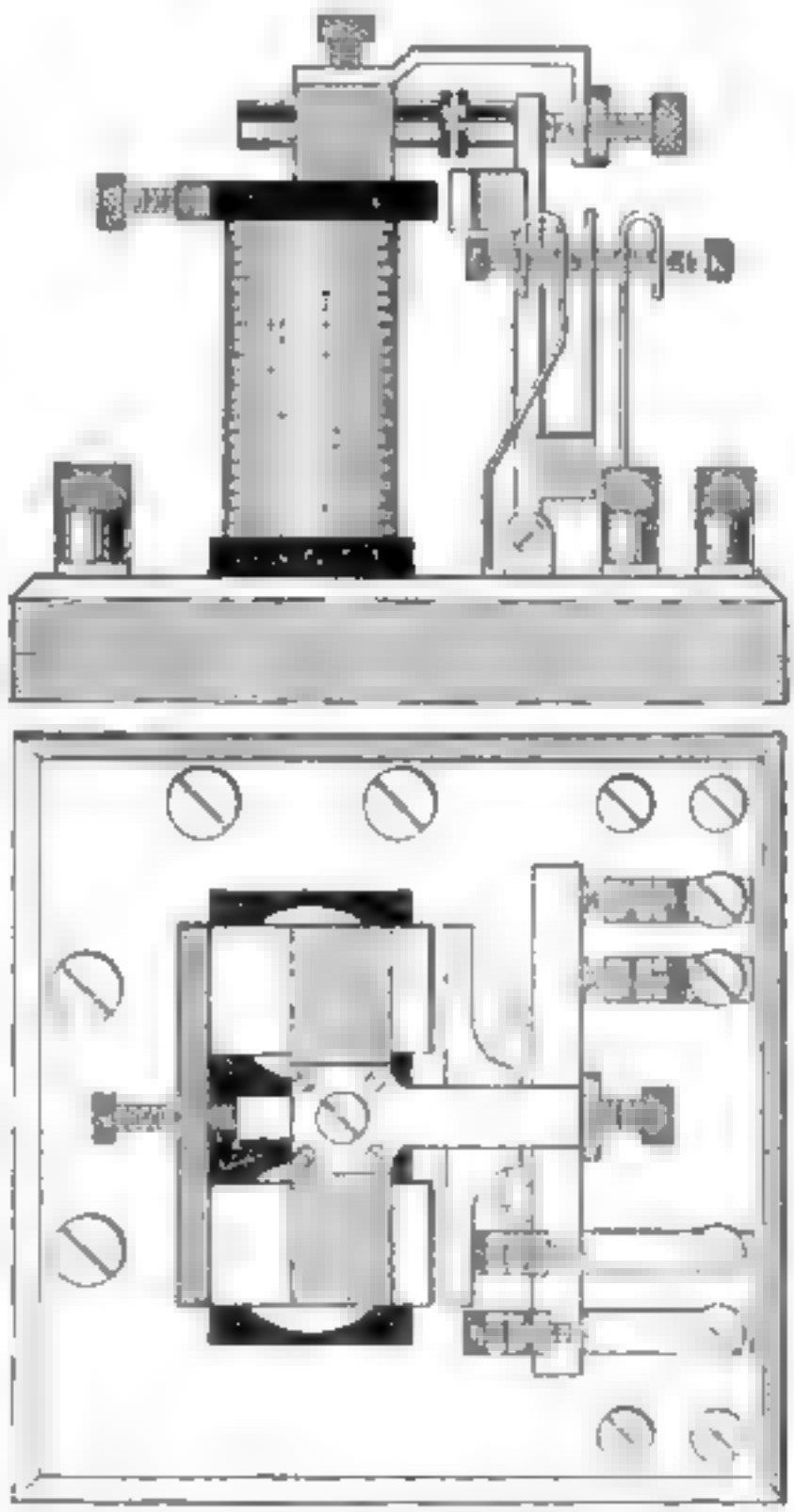
With it the lightest kind of a Morse key may be used for sending

By T. Lambert

THE average experimenter's "break key" consists of a number of springs, contacts, etc., which are attached to his regular transmitting key in a clumsy manner. To send clearly a code with key contacts ¼ in. apart is next to impossible. With the relay-key described herein it is possible to use the lightest kind of a Morse key for sending, since all the clumsy contacts of the breaks are on the heavier magnetic key. Further, no heavy current is handled by the small key and thereby arcing and sticking are eliminated.

A key as described has been in use in my amateur station for some time and has never given any trouble in holding the detector-adjustment, even with the most sensitive minerals, such as galena and cerusite.

The completed instrument is shown in the illustration. Four spring-contacts are employed, besides the alternating current break. The pair at the right disconnect the detector from the receiver when depressed. One of the contacts at the left shorts the telephones while the other one grounds the entire receiver while sending. It will be seen from diagram *B* that the receiving-tuner's primary is placed in series in the ground-lead of the oscillation-transformer.

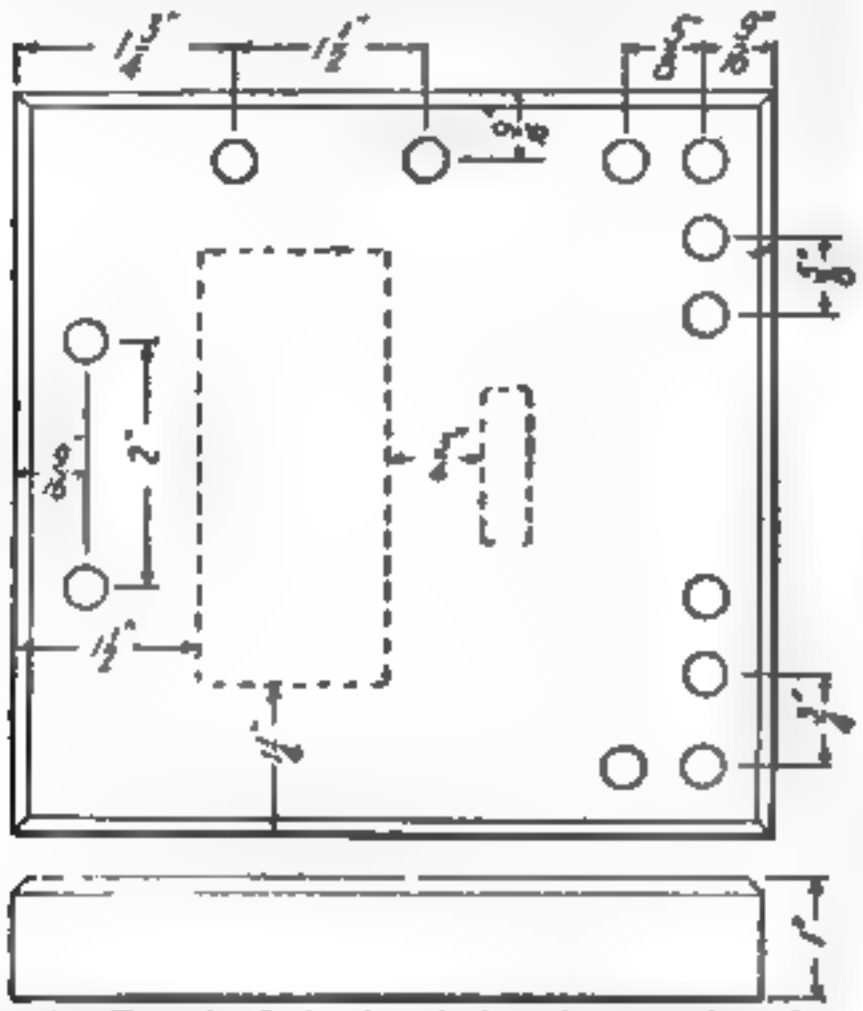


Four contact springs besides the A. C. break are employed in this magnetic break key

When sending, the high voltage currents from the transmitter pass directly across to the ground through the last mentioned contacts on the key. Some stray current may find its way into the receiver but will not damage either telephones or detector because they are amply protected by the other contacts. There is absolutely no danger of shock as all receiving apparatus is on the grounded side of the oscillation-transformer. The magnet cores are shown at *C*. A good grade of soft iron should be used, as it is less liable to hold residual magnetism. The cores are threaded to fit the end pieces snugly. The windings can be made directly on the cores after a layer of tape is placed, but it is preferable for ease in winding to turn out two bobbins on a lathe, as shown at *D*, and wind on them. Use number 20 D. C. C. wire and wind on eight or ten layers, placing a heavy sheet of paper between the layers. On the final layer glue a thin piece of ebonite to give it a finished appearance.

The brass crosspiece which holds the screw for adjustment of the tension of the spring *E* (page 159) is shown at *F*. The piece *G* is of hard rubber and supports the stationary primary contact as well as the yoke *H* for regulating the play of the key. It is attached to the top of the magnets with two machine-screws. The armature support is cut from ¼-in. brass. The contact and crosspiece holes are best located after it has been set up on its pivot *J*. This is also of brass, cut to the

dimensions shown. The easiest way to construct the pivot is to place the armature in the position it will occupy when completed, and then drill a 1/16-in. hole through both pieces and insert a piece of steel rod of that size. The armature itself is shown at *K*. This is of soft



A—Detail of the break key base giving dimensions for the locations of the parts

iron and can be attached to the armature with one machine-screw.

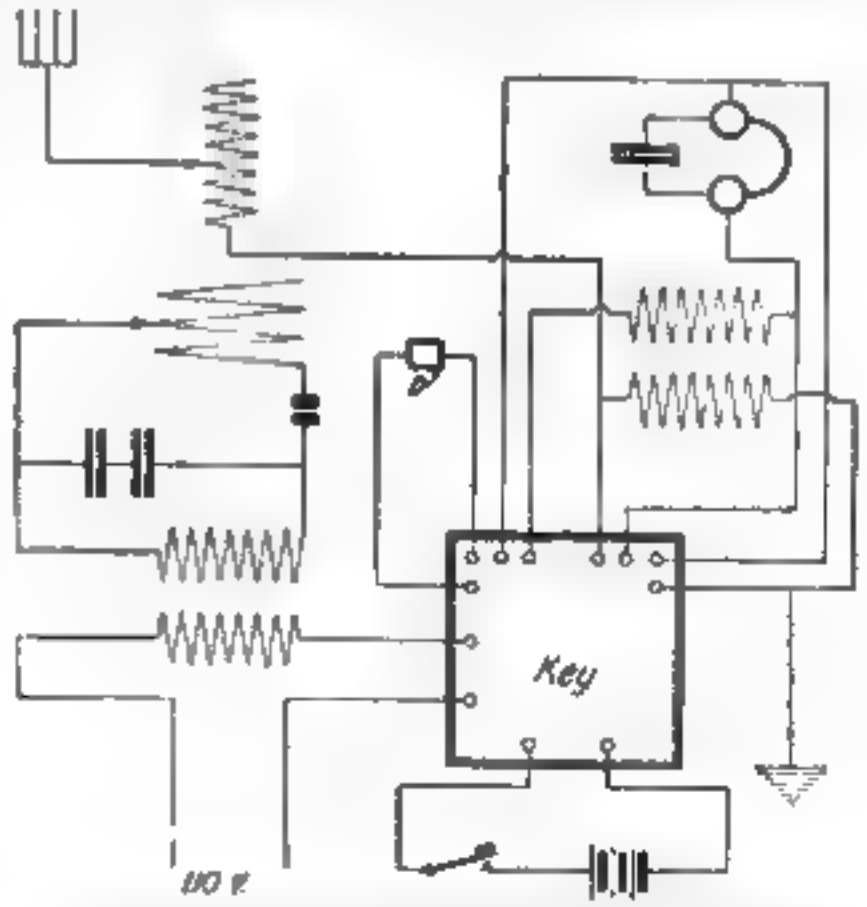
For supporting the contact-springs a hard rubber crosspiece, *L*, is employed. This is attached to the armature by a machine-screw. Holes are drilled in it to receive the machine-screws holding the phosphor-bronze springs, *M*, in place. A brass yoke is attached to the hard rubber crosspiece *G*, and holds the setscrew for adjusting the play of the armature. In the large end is drilled a hole of such size as to permit a 14/20 setscrew to pass without touching. Four smaller holes in the corners are used for attaching to the rubber piece.

A brass strip is bent to the shapes shown at *N* and supports the contact-screws. These are ordinary 8/32 brass screws. The loop at the upper end of these supports provides an automatic lock nut to prevent the screws from turning when once set.

For the contact-pieces 5/16 in. brass rods with dimes soldered on the ends are used. These are shown at *O*. If one is willing to go to the expense he can have silver plugs made by a jeweler, but in actual practise it will be found that dimes, when filed smooth on the faces, will carry all the current employed in most stations. The shorter contact has a threaded stud which screws into the armature. The other one is made adjustable by means of a setscrew in the hard rubber crosspiece. A good way to get the dimes together in the same plane is to set the brass shanks in their proper places and clamp the two dimes between them and then solder. On separating the pieces it will be found that they are in perfect alinement and meet exactly when the key is in use.

The various parts are assembled on a wooden base of the dimensions shown at *A*. Heavy binding-posts are mounted as shown in the drawing of the completed instrument and the connections from the moving springs brought down to them by flexible cord. The magnet-leads are brought to the posts in the rear and the main break-contacts to the side posts. The dotted lines are the locations of the magnets and pivot. For setscrews, fillister head brass machine-screws, about 8/32 size may be used.

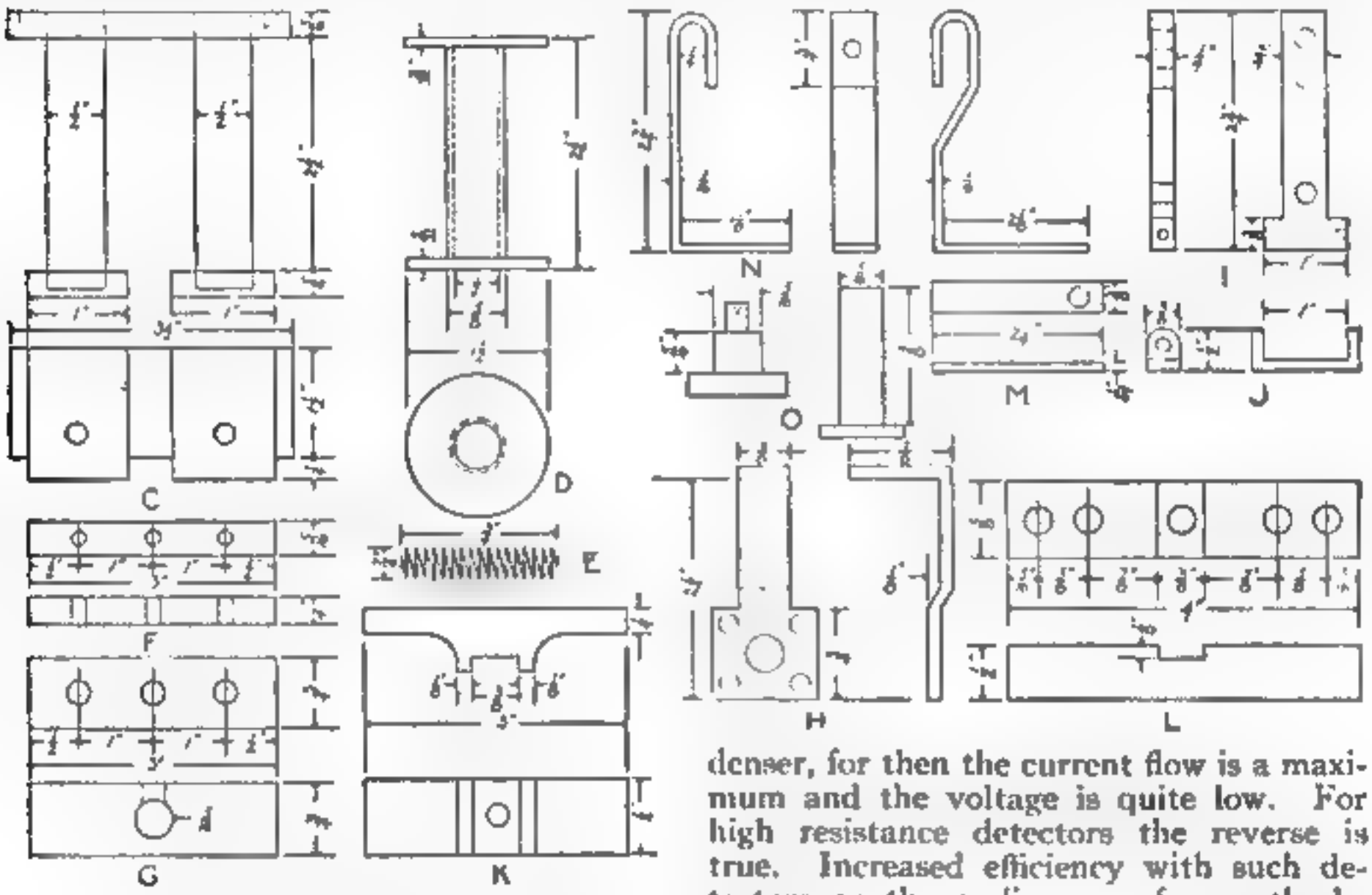
The connection with the other apparatus is shown in *B*. The detector in this illustration is shown at *D* and should be placed as close to the key as possible, since long leads have induced in them currents that are liable to throw the crystal out of adjustment and make the break-in useless. A battery of about ten volts should be used



B—The receiving tuner's primary is placed in series in the oscillation transformer

on the magnets. Less would be sufficient but would not give the snappy action so much desired.

The contacts should be gone over frequently with very fine sandpaper, as a poor contact is liable to cut down the efficiency of the receiver to no small extent. The left contact-screws are adjusted to touch the springs when the key is depressed while the right hand pair are to make



Detail of the parts that enter into the construction of the magnetic break key

contact when the armature has come back, and to break the contact when it has been drawn to the magnets.

A little experience will make it possible to get an adjustment where there is no sparking at the contacts and no noise in the telephones.

I doubt if anyone, after using a key such as described, will ever willingly go back to the old clumsy aerial switch.

An Emergency Form for Winding Motor Fields

RECENTLY my rotary spark-gap, 110-volt A. C. motor burned out one of its fields. As I was in a hurry to use it I tried a quick method of rewinding the coil by driving a series of nails into a wood face-plate on a small lathe and winding the wire on them. After winding the coil I bent the nails together so that the coil could be slipped off.—EDWARD MCCLURE.

Loading Coil in Series with the Secondary

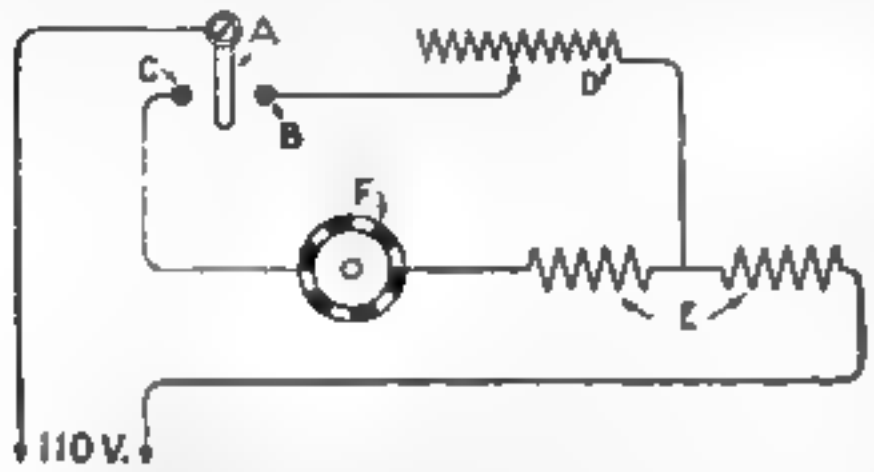
WHEN a low resistance detector is used, it is a good plan to tune the secondary circuit by using a comparatively small inductance coil and a large condenser, for then the current flow is a maximum and the voltage is quite low. For high resistance detectors the reverse is true. Increased efficiency with such detectors as the audion can frequently be secured by inserting a loading coil in series with the secondary, and correspondingly reducing the capacity of the tuning condenser. This applies the highest possible voltage to the grid.

Effect of the Moon and Season on Wireless in the Tropics

WHILE stationed in the tropics for several years as a wireless operator, I observed that in the periods of a full moon, or thereabouts, the atmospheric interferences are slight and the ether seems to carry the wireless waves with less absorption than when the moon is in its quarter periods, or thereabouts. With a full moon, and using the same receiving set, I could receive from stations that were about 200 miles farther away than those which could be heard when the moon was in its first or last quarter. Also, during the winter months from about the first of December to April, there seemed to be better atmospheric conditions.—J M. COHEN.

Magnetic Brake for a Wireless Rotary Gap

THE radio experimenter who uses a rotary spark gap in connection with his sending apparatus is usually troubled with interference in his receiving set caused



Eliminating the interference of inductive noises from the motor of a rotary gap

by the inductive noises from the motor of the rotary gap, which if well balanced takes some time to come to a full stop.

In the drawing, *A* represents the blade of a single pole, double throw, switch. The figures *B* and *C* are the two jaws of the switch. The figure *D* represents a rheostat by means of which the length of time necessary for the motor to come to a full stop may be regulated. At *E* and *F* are the fields and armature of a series-wound motor.

The action is as follows: To start the motor, throw the blade *A* to contact *C*. When through sending, throw blade to contact *B*, which causes the current from the line to flow to one field through the rheostat *D*, and results in stopping the motor in two to three seconds. After the motor has stopped, disengage the switch blade from jaw *B*, otherwise a waste of current will result.—PAUL J. HOFFMAN.

Adjusting the Detector of a Receiving Set

WHEN the crystal or other detector of a wireless telegraph receiver is adjusted by the use of an ordinary buzzer set up near the instruments, it is often noted that the point of contact which gave loudest response to the buzzer is not that which is most sensitive for receiving signals from long distances. The most sensitive spots sometimes do not give loud sounds when the local buzzer is operated.

This has been noted by many experimenters who have electrolytic and crystal detectors in use side by side; generally the crystal will give the loudest signal when the buzzer is worked, but the electrolytic will prove better for receiving from stations far away. This is because the character of the test impulses produced by the ordinary buzzer is quite different from the radio frequency-currents set up in the receiving aerial by the distant station.

In a patent (No. 1,176,925) issued during 1916 to G. W. Pickard, there is shown a method of avoiding this difficulty. As indicated in the drawing here reproduced, a buzzer having armature *A*, contact *B* and magnet *C* is connected in series with battery *D* and test key *E*. Across the vibrating contact is shunted a high-frequency oscillating circuit comprising the condenser *F* and the inductance *G*. This last named element is coupled variably to the secondary *H* of the receiving oscillation-transformer, which has the usual tuning condenser, detector, blocking condenser, telephones and potentiometer arranged as shown. The shunt oscillation circuit *F*, *G*, is adjusted to produce feebly damped groups of radio frequency-current corresponding to the wavelength most used at the receiver.

When the buzzer is put into operation by pressing the key *E*, there are generated in the transformer secondary radio frequency-currents corresponding to those received in actual radio telegraphic practice. The groups produce tone signals, of the buzzer interruption-frequency, in the telephones. The loudness of these signals depends upon the coupling between the coil

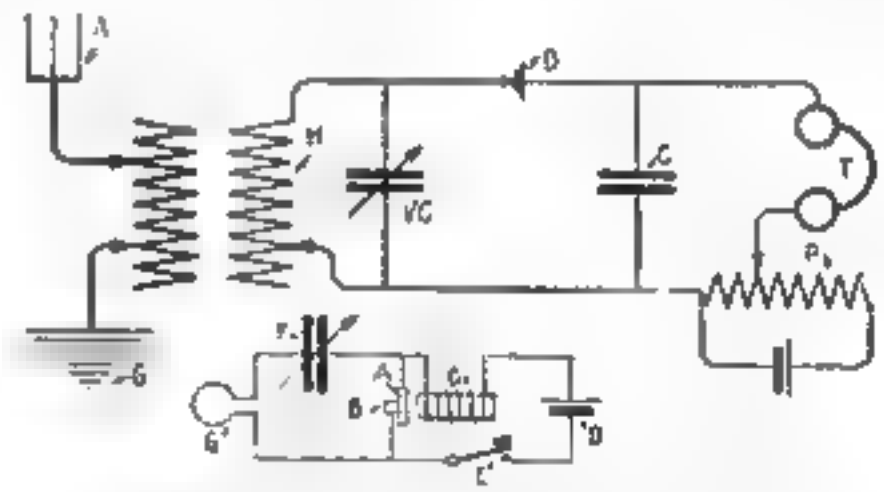
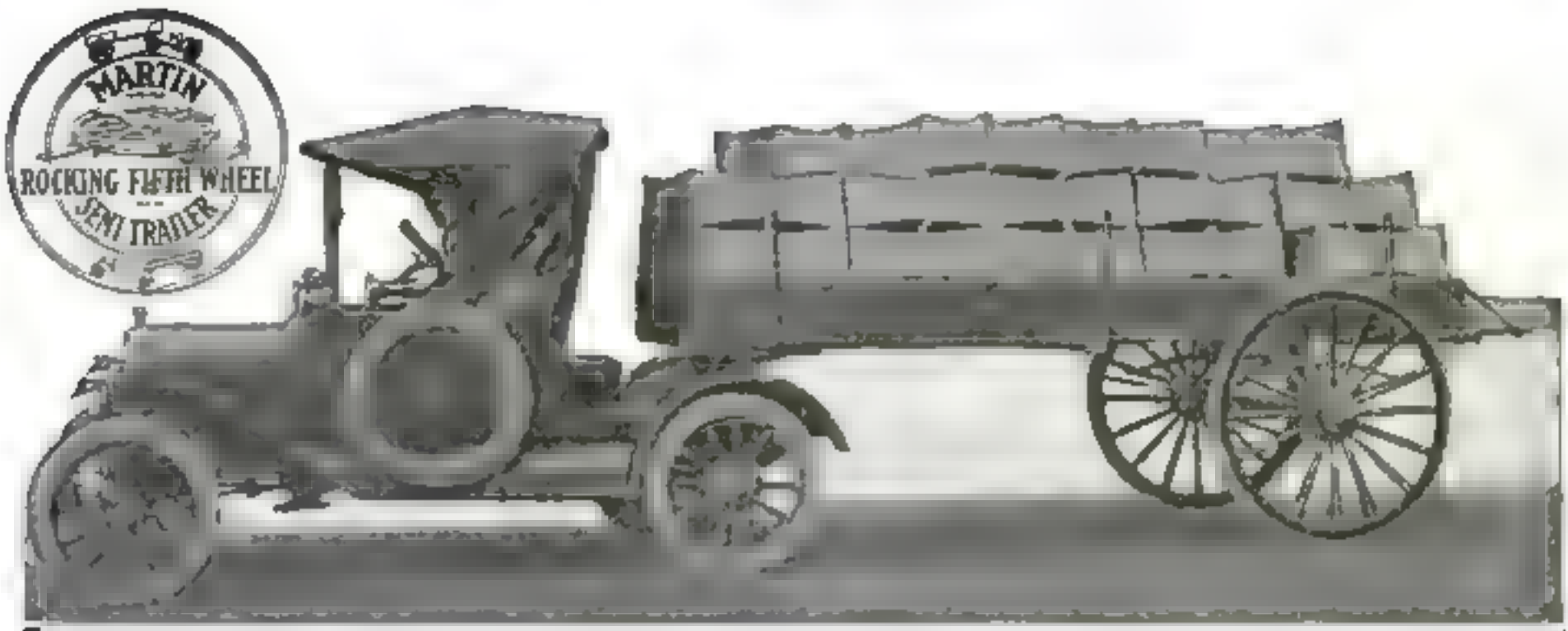


Diagram of connections for buzzer exciter which permits accurate setting of the crystal

G and the secondary, and upon the true sensitiveness of the detector. By selecting the point of crystal which gives loudest responses to such excitation, when the buzzer coupling is set to produce an intensity corresponding to that of the station which it is desired to receive, the operator may have entire confidence that his detector is properly prepared to do the best work.



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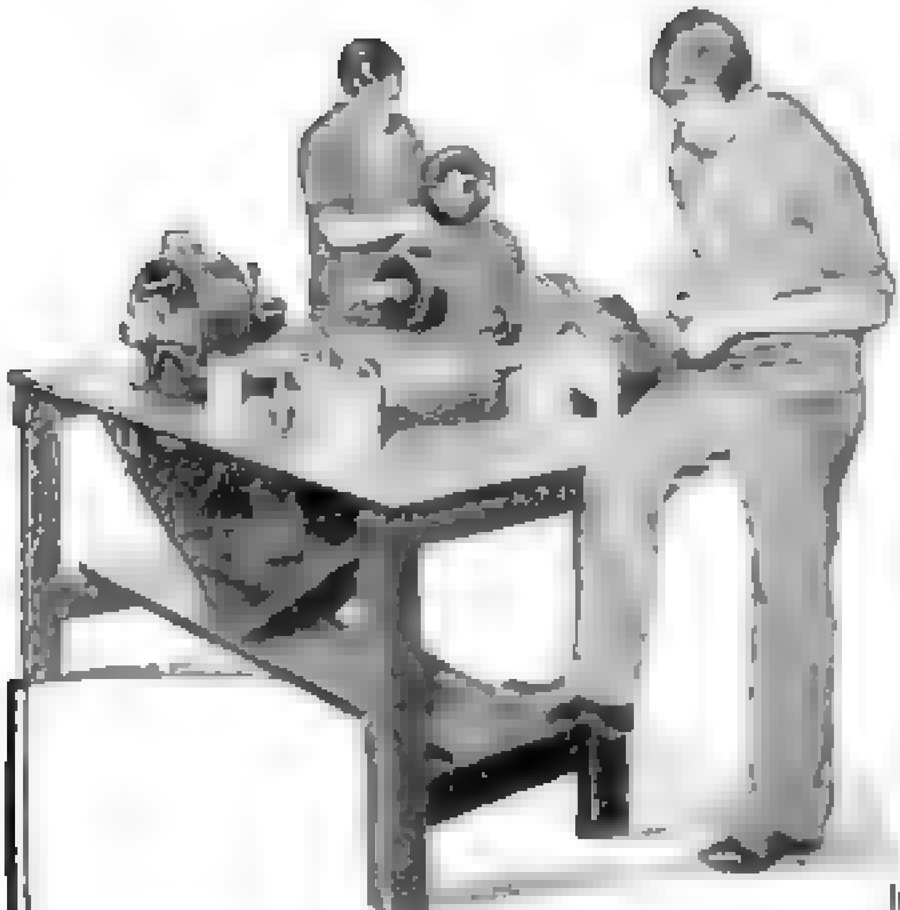

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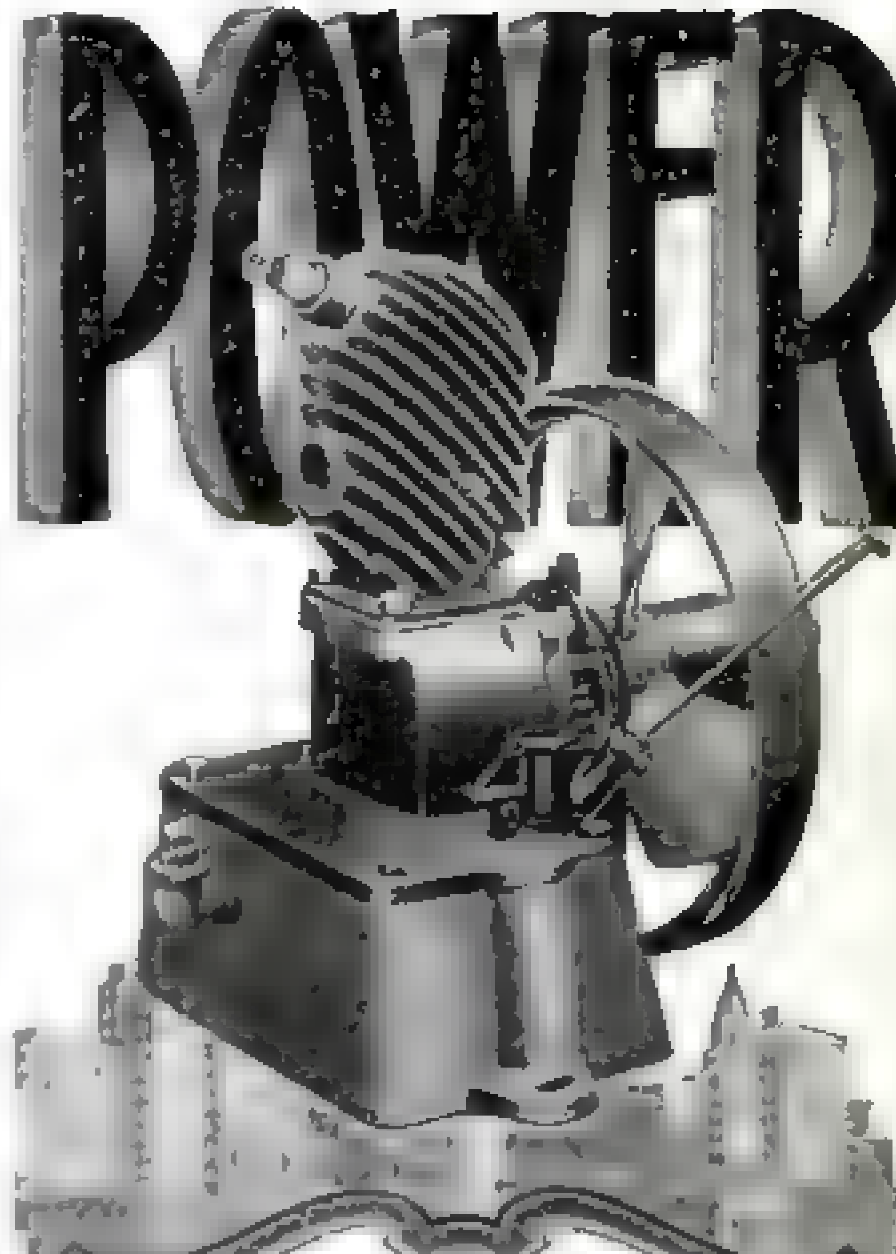

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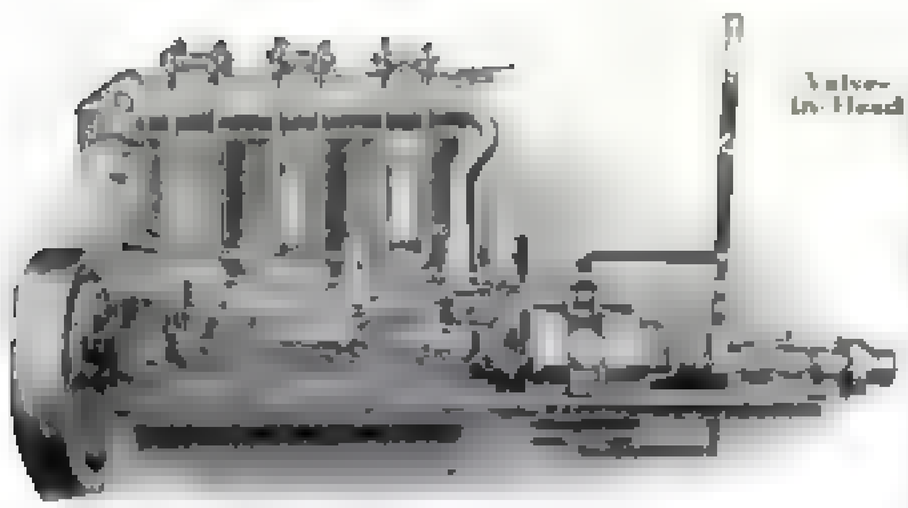

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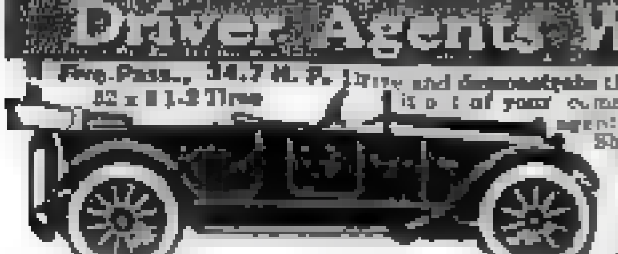

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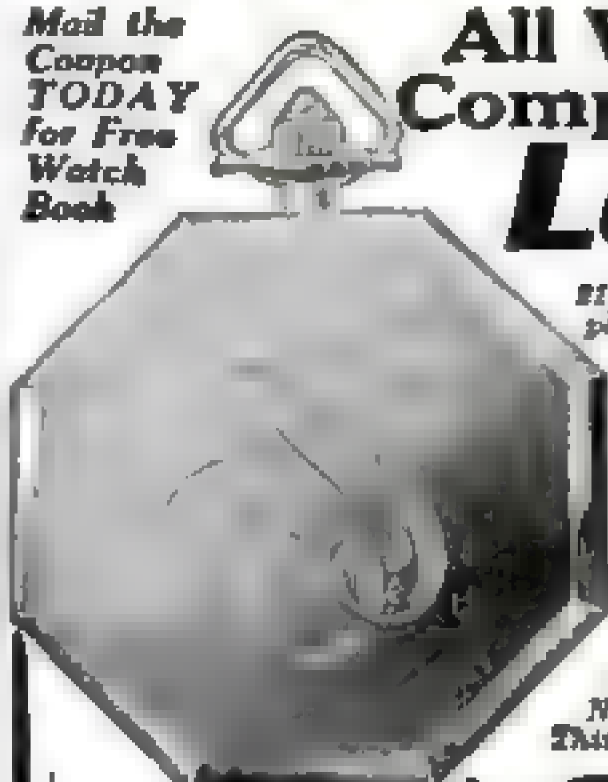

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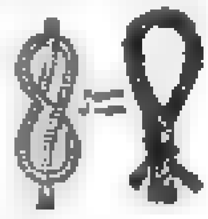

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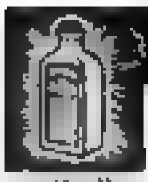

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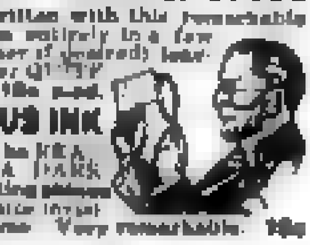

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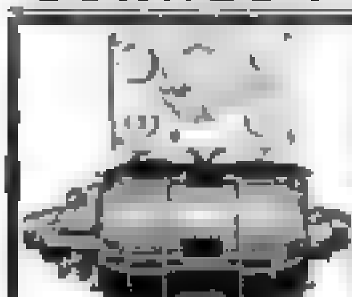

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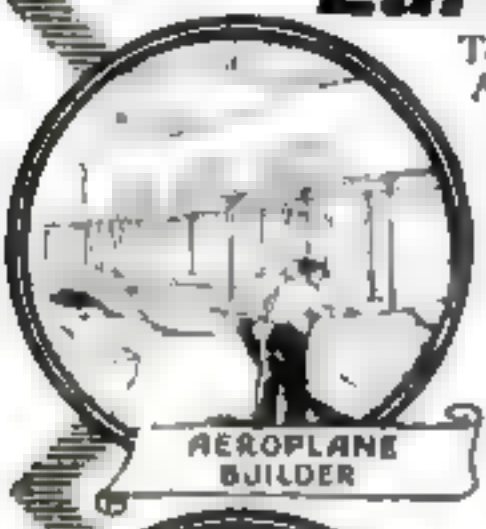

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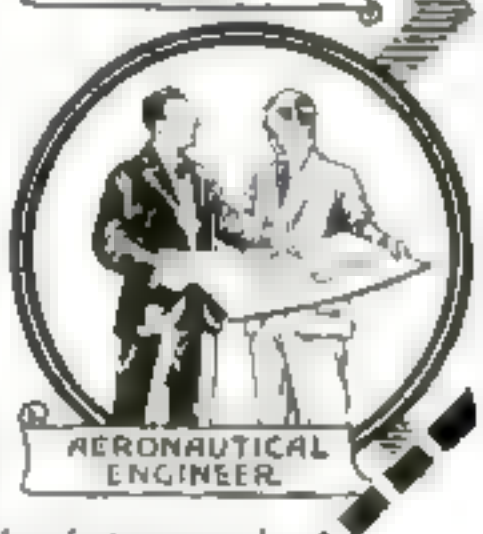

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